

in
BEST AVAILABLE COPY

Wolfgang Wagner
Karlsruhe (Baden, GFR) (Birthplace), Resident: Berlin

1 I am the applicant for the patent

the *in vivo* effect of an oral, non-hormonal, contraceptive

~~for me to get to work, that I don't have to go to work~~

2. The basic application as defined by section 141 of the Act was made in Munich (GFR) on the 7 th. day of September 19 85 by myself Sect. Berlin

PCT/ DE 85/ 00313

3 I am the actual inventor of the invention referred to in the basic application.

Reason other than the above is the applicant:

3

~~The subject of the above letter is as follows:~~
~~It is requested to make the explanation as follows:~~

4. The basic application referred to in paragraph 2 of this Declaration was the first application made in a Convention country in respect of the invention the subject of the application.

(or, where a request is made under section 142AA of the Patents Act 1952, for an earlier application made in a Convention country to be disregarded);

4.-(1.) The basic application referred to in paragraph 2 of this Declaration was not the first application made in a Convention country in respect of the invention the subject of the application.

(2.) An earlier application in respect of the invention the subject of the application was made in

Munich/Berlin^{on} 7.th day of September 1984, now abandoned not publ.

(3.) A request has been made to you under section 142AA of the *Patents Act* 1952 to disregard that earlier application.

(Here set out in succeeding sub-paragraphs the facts that show that section 142AA is applicable)

The earlier Appl. P 34 33 265.7 relates to Fig.36-43,48,49,58;

The Partial Priority for the other parts of Appl. should be claimed
Except as stated in this paragraph, the basic application referred to in paragraph 2 of this Declaration
the first application made in a Convention country in respect of the invention the subject of the application.

Declared at Berlin 65 this 14 th. day of March, 19 86.

Nancy J.
(Signature of Declarant)

10:

THE COMMISSIONER OF PATENTS.

(IMPORTANT - Cross out inapplicable words in above Form.)

APPLICATION FOR A STANDARD PATENT
OR A STANDARD PATENT OF ADDITION

Form 1 -
Regulation 9

AUSTRIA

25 MAR 1986

PATENT OFFICE

I, Wolfgang Wagner
of 1000 Berlin 65, Exerzierstr.1 (Germany)

hereby apply for the grant of a standard patent for an invention entitled A DEVICE
patent of addition

FOR AUTOMATICAL SELF-CONTROL OF METABOLISM

which is described in the accompanying provisional specification.
complete

*(To be included in the case of a Convention application)

Details of basic application(s) -

Number of basic application

PCT/ DE85/00313 Entitled: Injektions-
vorrichtung mit Sensor,
Injection Device With Sensor

Name of Convention country in which basic application was filed Munich (GFR),

Date of basic application

*(To be included in the case of an application made by virtue of section 51)

Number of original application

Person by whom made

*(To be included in the case of an application for a patent of addition)

I request that the patent may be granted as a patent of addition to the patent applied for on Application

No. Patent No.

in the name of

I request that the term of the patent of addition be the same as that for the main invention or so much of
the patent for the main invention as is unexpired.

My address for service is Mrs. R. J. K. Chapman
25 Jenkins Street, 7006 Taroom, Tasmania 278209

Dated this 14 day of March 19 86

To:

Wolfgang Wagner
(Signature)

THE COMMISSIONER OF PATENTS

This form must be accompanied by either a provisional specification (Form 9 and true copy) or by a complete specification
(Form 10 and true copy).

* These sections are to be completed only where applicable.

(12) AUSTRALIAN PATENT ABSTRACT
(19) AU

(11) AU-A-55604/86

(54) MEASURING METABOLISM DURING LIQUID INJECTION
(75) WOLFGANG WAGNER
(21) 55604/86 (22) 25.3.86 (24) 7.9.84
(31) PCT/DE85/000313 (32) 7.9.84 (33) WO
(43) 8.10.87
(51)⁴ A61M 5/31 A61B 5/05
(57) The invention relates to the treatment of diabetics.
Claim

1. A device for the automatical self-control of metabolism of a mammal, consisting of at least one sensor which is to be connected with a measurement device and which is arranged in relation to a skin knob produced by a mechanical apparatus in such a manner that an additional blessure of the body may be avoided for the measurements.

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PATENTS ACT 1952-1973

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE

Class:

Int. Cl:

Application Number: 55604/76.
Lodged:

Complete Specification—Lodged:
Accepted:
Published:

Priority:

Related Art:

TO BE COMPLETED BY APPLICANT

Name of Applicant: Wolfgang Wagner

Address of Applicant: Exerzierstr.1 1000 Berlin 65

Actual Inventor:

Address for Service:

Mrs. R. J. K. Chapman
25 Jenkin Street, 7006 Taroona, Tasmania
Complete Specification for the invention entitled:

A DEVICE FOR AUTOMATICAL SELF-CONTROL OF METABOLISM
The following statement is a full description of this invention, including the best method of performing it known to me:—

*Note: The description is to be typed in double spacing, pica type face, in an area not exceeding 250 mm in depth and 160 mm in width, on tough white paper of good quality and it is to be inserted inside this form.

Dr.med.Wolfgang Wagner Berlin
A Device For Automatical Self-Control
Of Metabolism.

A B S T R A C T

5 The invention relates to a cannula; it permits, by
the particularity of its shape or features and
by the combination with a measuring arrangement,
to judge or check and to registrate conditions
10 or states of metabolism; this is done, of course,
before and during liquids are injected into the
body of a mammal and preferably on persons suf-
fering from renal sickness and mainly on diabetes.
But essentially, the scope of the invention concen-
15 trates to an injector, which adapts, before or
after the tissue sugar (content) is measured, cor-
relates the measured data to a preadjusted dosage
and a dosage correction; it adapts, if need be
and corrections are necessary more frequently,
20 the programming to the dosage automatically.
Preferably, this takes place into a suction in-
jector, which raises the skin by negative pres-
sure or vacuum into the cannula, and which re-
liably considers the continuous operation of
25 measurement and injection by control of the
reventilation. Besides of the features of the
sensor cannula with regard to its form and lo-
cation and kind of sensor layers and electric
or optical measuring feelers or sensors, the
30 main-attention is directed to improvement of the
suction injection as regard of handiness and
simplicity of operation and prerequisites of a
compliance. The manner of production of nega-
tive pressure or vacuum and of the dosing and of
35 the steering of functions are dealt in this sense.

S P E C I F I C A T I O N

General Object :

5 The invention relates to the field of medical technology, in particular to injector technology, wherein the treatment of diabetics in the dispensation of insulin is improved by the invention. The patient is to be put in a position to regularly and repeatedly recognize the state of his metabolism so as to make it easier for him to keep a reasonable diet and to allow him, when deviating from a strict norm in his behaviour, to compensate said deviation by a commensurate insulin treatment. Therefore, the physician treating the patient should be accorded an extensive knowledge and insight into the nutritional comportment of the patient so as to put the physician in a position to match his dosing proposals for insulin relative thereto. This idea in mind, the problem poses itself to provide an injector which can be handled automatically as to its operation in such a manner that the person stricken with the disease can use it, but also to allow for an application several times during the day. To this purpose the injector should be of a construction which is small in size and easy to handle, safe as to its operation, constituting no hazard as to health and

capable of use with least inconvenience. It is an object to render handling thereof -also with respect to refilling it with insulin of using a new cannula- as easy as possible and the cost of manufacture as low as feasible. When applying said suction injector it is of particular advantage to combine therewith diabetomentering in conjunction with the injection while raising or lifting the skin by means of negative pressure into the cannula, assuring in this way until the time of reventilating the suction cup a fixed union of injector and skin. In this respect further improvements in the suction injector technic relate to adapting it to the storage, the mixing performance and the dosage of insulin but also to the generation and application of the vacuum or negative pressure.

The attempts during over fifty years with the project to bring the suction injection to an employment worth mentioning show, that only a complex treatment, whereby all functional parts and the human(above all but the psychical) constitution are coordinated one with the other, produces a solution, which is advantable and also manufactory useful. Opposite the disposable syringe with long stroke and incorporated cannula which meanwhile is easier to handle(but more expensive), a full automatic injector must be small to put in the pocket and handy, reliable in function, easily to use, favorable with respect to the costs. Concerning to the diameter of cannula it must be observed the minimum to avoid additional violation and molestation. Opposite to the conventional syringe must be offered additionally essential advantages as those are given by the dosage adaptation according to sugar-measurements and including the possibilities of control and training and education are suitable to increase the compliance.

Investigations of metabolism directly at the bed of the patient by automatically taken samples are known long since, whereby also measuring data are stored (for example Hudspeth, C.L., Richardson, Ph.Cl. and others in DE 24 37 467).
5 For example with the insulin-infusion-device Biostator of the firm Miles it became possible the continuously supply of insulin by observation of glucose concentration in the last years.
10 But the comparatively extensive apparatus is applicable only at the bed of the patient. The "Implantable Electro-Chemical Sensor", so as is specified by Leblanc jun. and by others (DE 26 45 048) is introduced inside of a coating
15 cover into a vessel and serves to the observation of ion-activity. It shows liquid supply by means of a drop-infusion. It is also proposed to take blood samples by a laying probe for analysis (Clemens, Anton Hubert, E. Myers, R. Weston, DE
20 27 20 482) and the separated supply of glucose and insulin is controlled. To the here demonstrated invention at most Ash St.R., Lafayette, Loeb M.P. mostly approach with their "Arrangement for the apply of insulin as required" (DE 30 50
25 155). To a insulin supplaying cannula a sensor with coating cover is attached directly for the common introduction under the skin. In contrast to a specific enzymatic reaction with glucose which is susceptible for disturbance the osmolarity of the blood is measured and drawn off from
30 an eventual deprivation of water by simultaneous determination of salts. The results of measuring are arithmetically fitted with the dose program. The insulin pumps, which must be weared with laying durable cannula, further useful,
35 especially for juvenile persons and such with instabil diabetes serves to the apply of minimal amount of

insulin which is to control with the possibility of arbitrary alterable additional doses before the meals by the patient himself. (For example: Haerten, R. and Kresse, H. DE 25 13 467).

5 A measuring device for blood sugar here is not present. Loeb, M.P. and Olson, A.M. (DE 32 41 313) give a curved arranged syringe which is to bear on the body by use of catheter. For the implantation into the body also several pumps with supply vessels are described. (For examples Cummins, R.D. and Park, 10 O DE 33 43 708). On is occupied with the wireless transmission of demands for dosing to such a device (Prestek, K. and Franzeski, M. DE 30 35 670) and with function control over measuring dates out of the inner part of the body, whereby a locking 15 mechanism is provided for the transgression of a limiting value of the insulin infusion. (Fischell, R. and Ellentuch, DE 32 47 232). Also the title "The Development Of A Needle-Type Glucose 20 Sensor For Wearable Artificial Endocrine Pancreas" (Yamasaki, Y. Journal of Osaka Univ., Vol.-2, Sept. 1984) should not deceive, that here is the question about a head-probe with a complicated layer structure which is implanted to dogs under narcosis and that the inventive scope of coating 25 the cannula is not mentioned. The sensors coated on wire of Wilkens, E. and H.G. Daniel, R. and others and Gough A. and others seem us more practicably, which are more exactly cited with the description of the sensor cannulas. 30 But altogether such "catalytic sensors" with the sense of current producing cells involve considerable problems, even because the continuous application inside of the human body is intended. Although optical systems also are not with less 35 problems with regard to the competition of materials

(p.e.to the amino acids which turn the plane of
polarization) Mueller A. was involved with in-
vivo-measurements (DE 29 441 13) through external
ear. Such obtained continuously measured data
5 certainly could be applied for a better dosing
correction in suction injection. Less awkward
could be presumed to remain the measurement
through the cannula. For the binding of cardiac
glycoside and for other sugar derivates sepharose-
10 concanavalin A is used some time. On the other
side is known, that sugars are no-conductive and
increase in higher concentration the voltage of
a electrolyte solution; that the cause, that
voltage measurements are used in the sugar che-
15 mistry to track down sugars (A fact, which I owe
to the personal information by Prof.Dr.Mauch Ber-
lin).

The plaster-adhesive fixation of skin during the
injection has also precursors, but yet without a
20 elevation of the skin.
Suction injection technic -i.e.injection by way
of applying suction from within a suction cup on-
to a portion of the skin raised thereby- which
has been improved upon by Applicant and which
25 has been also disclosed starting on Nov.7th.1933
by M.Demarchi(US.PS 1,934,046) and by G.N.Hein
(U.S.P.S.2,743,723 as of May 1st 1956), in sever-
al disclosures of Applicant beginning with 1974
(GB 1,494,325; 1,494,646; 1,513,463; 1,517,289;
30 DE 25 51 991; 25 51 992; 25 51 993; 30 19 589;
Australia 510,272; US. 4,139,008; 4,169,474;
4,284,077; 4,393,870; Can 1,189,412 and many
others) which technic has not yet led to exten-
sive use and application on account of imperfec-
35 tions in the human nature although human skin is
well suited for suction injection, and this on

account of its particular elasticity and hypotri-
chosis or thin-hairiness. To start with, G.H.
Hein disclosed already in 1956 a device whereby
a premature penetration into the skin prior to the
injection is safely obviated, yet the more impor-
tant measure to provide for the right spacing
from the skin to the cannula subsequent
to the injection had been neglected. Likewise, the
methods for generating the vacuum are also not
satisfactory. In this respect, it is a matter of
course, to satisfy the prerequisite for one-han-
ded operation thereof in affording self-treatment
to the diabetics. Moreover, the dosing system
comprise a number of shortcomings. An injector
disclosed by Stein W. (DE 1 491 840) uses, to be
sure, the principle according to which drug feed
is carried out from a supply bottle by means of
the dosing injection piston via a valve disposed
therein; yet, the necessity of separating ambient
air from the contents of the supply bottle has
not been dealt with. The injection without the
use of a needle by means of excessive pressure or
overpressure forbids itself when effecting long-
term treatment on account of the damages to the
tissue resulting therefrom. Besides, the necessi-
ty, to avoid that the patient would have to clean
the component parts of the device, has, so far,
been afforded too little consideration.

Advantages of the Invention:

It is to great advantage to the diabetic as well
as to the patient with implanted insulin pump if
he were able to find out his metabolic state with-
out additional damage to himself by inflicting
scratches of those parts of the skin of the tip of
the finger especially rich in pain and without the

rather cumbersome procedure of applying a test strip and reading therefrom the colorimetric data, and to do this while effecting himself said injection or, selectively, even before actuating the injector piston. On the basis of those measured data and the dispensed dose of insulin it is possible for the patient and the physician to fully take account of his situation as to therapy, and also he will more readily understand it, with the help of his physician. When effecting the separate or individual measurement -possibly via the sensor layer or coat of the cannula as current source or via measuring the modifications in conductivity under the influence of glucose -with the aid of the cannula constantly replaced for a new one, sources of interference will be eliminated such as protein or electrolyte accumulation at the measuring sensor, which would render a long-term application more difficult. The suction injection present, in connection with the metabolic controlling sensor cannula, the particular advantage that the duration of skin contact is automatically controlled. Moreover, it is of advantage for measuring means to provide in the suction cup rim in the vicinity of the cannula a comparison or reference electrode which assures fixed adhesion thereof and need not be attached by specially provided means. Countersinking the cannula shaft to a type of skeleton cannula accommodating the drug guide channel will eliminate the necessity of providing for thickening or swelling of the cannula by the sensor coating or covering whereby an essential advantage relative to the painful sensitiveness of the puncture due to the modern delta type ground cannula and suction injection would be cancelled. By way of di-

viding the cannula shaft into the metallic skeleton part and an adjacent sensor part -which may also be mounted on the hoses introduced into the groove-like cannula shaft- there is a possibility to effect a division between two electrically separated portions having their proper electrical paths, and to gain in this way an additional reference electrode.

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A hose, which is shoved onto a such half-open cannula, may have a smaller clearing or lumen for piercing through the skin, which results in being expanded up due its elasticity. In such a manner, a more quickly injection may be rendered possible (p.e. such of viscous liquid solution or of a suspension, as retard insulin often represent). A further advantage results in the possibility, that foreign matter, which rests to the surface of hose, contacts with the tissue fluid or with the blood, but an introduction of such foreign matter can be avoided.

25
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The automatic compensation of dosage relative to the respectively determined metabolic conditions excludes miscalculations and misestimations as well as erroneous operation of the patient, while allowing for taking varying insulin sensitivity due into consideration. Moreover, the automatism of the program permits that a crudely erroneous program will be corrected by the physician or, also, an andaption to new conditions of living and nutrition without having to have recourse to the assistance of a physician. Applying instandly active unmodified insulin and depot insulin side by side permits that- similar as with the insulin pumps- a short-term correction can be effected in addition to long-term physical care. However, in this connection the detrimental effect of having to carry on one's body some

device or apparatus is eliminated as is the drawback of having to have implanted in the peritoneal cavity or in the subcutaneous connective tissue a cannula which may also constitute for the patient a source of imminent danger as regards wound infection. Programming by means of contact is segmented into blocks and rotatably disposed in the housing will, in this respect, facilitate the overview. The selection of the profile number permits print out of the entire program line into the file of the patient, and this without the use of complicated technical equipment. Closing the program away and restricting the possibility of compensation and changes of program by the patient are indispensable prerequisites for avoiding serious incidents due to misconceptions, self-willedness and lack of discernment of the patient or deliberate interference of third parties. It appears of particular advantage to effect, as regards the domain of vacuum generation, an advance or shifting forward thereof into the phase of industrial packing of the cannula, and this in particular when this is done because of the higher expenditure of the tripping mechanism for a reservoir cuplet preserving said vacuum and surrounding the cannula to be used but once on the injector which is used over and over again. It is possible in this connection transform modifications in the surface of the reservoir cuplets during the sucking up operation of the skin into pulses via feeler members of the injector so that direct skin contact of the feeler for tripping operation can be omitted. When using using electrically operated dosis dispensation especially the solution of vacuum generation presents itself via rarefaction of air within a heated chamber. Employ-

ing a plurality of chambers increases the independence from the mains and, hence, its wide range of multifarious daily use. Likewise, the advantages of a permanent vacuum controlled or adjusted according to the instant command or deed can be exploited with a handy apparatus by employing gasless or injector pump in connection with a common hold carbonic acid cartridge after the manner of account of the high gas output pressure and icing when the gas is expanding- is removed by means of a special shutter or paddle valve. Finally, vacuum generation can -in view of the low vacuum requirement- be carried out in a spring operated cylinder-piston pump when, by filtering the air from the suction cup, it is obviated that piston and cylinder are affected by the finest quartz grains from the pores of the skin with respect to their surface finish or skin effect. Suitably, vacuum preparation is shooked up with the movement of a catch cover for the suction cup, while also actuating the mechanism for replacing or changing the cannula. Bowden cables permit a space saving power transfer. The fact that clamping or locking of the suction piston is carried out on but one side by lateral grip means with the risk of cogging the piston is counteracted in that the suction piston is held by magnets and spring locking means already approximately in snap-in or engagement position. The quantity of power that need be applied for tripping from the suction cup is, therefore, considerable reduced. Also, a delay of pump movement sets in which can be used for closing a pressure relief valve. This latter effect is to divert the air compressed in the suction cup by having

fore resiliently held by grid or a central pin within the suction cup, serious cuts on the skin are obviated when the device is removed, inadvertently, tangentially from the skin after having been used. It is also an advantage that the cannula magazine as a whole can be raised under the effect of suction in the suction cup onto a septum connected to the magazine - depressed on the skin prior to injection and raised again upon re-ventilation.

In the field of operational control, in particular as regards operation safeguard between the steps of skin suction, drug injection and reventilation of the suction cup advances will also be described. In this connection, a central pin within the suction cup in the vicinity of the cannula establishes the state and extend to which the skin has been raised. The three tripping pins also, which are spaced about the periphery of the suction cup, as shown in other embodiments, have been improved by suitable spacing and arrangement and in that their spring-back resiliency onto the skin, subsequent to its having been raised, is cancelled and reduced. The interval or space from skin to cannula is assured, subsequent to injection and in order to avoid cut wounds, by spring-back action- being in part blocked during injection- of the suction cup. Reventilation of the suction cup is, safely, effected first after the injection has been terminated (in the embodiments with mechanical control) when a spring mechanism has actuated the moving members controlling the dosis up to running up to the obstacle limiting dosis. The spring mechanism is to be equated with the magnetic attraction of the ventilating valve, flutter of said valve -when applying permanent suction- being prevented by means of a special locking mechanism.

The central pin occupies suitably a central point of an elliptical suction cup, with the cannula occupying the other for keeping the necessary distance of the seals about the the central pin and the cannula and of the suction cup rim.

5 By using a swelling pin for lifting the gas capsule in the mandrel renders a relatively weighty screw lock and a mode of handling superfluous which requires much force. As regards

10 storing and feeding the drug or preparation is effected so that a uniform flow of the drug is safeguarded towards the dosing device. A process of refilling, so as to build up a residual amount to accumulate as dosis which can be applied,

15 leads to saving expensive hormones, in particular when magnetic locking means allows the exchange of the supply reservoir only then when the one used has almost completely been exhausted. With regard to dosing, the dosing precision is increased by

20 avoiding lengthy and extensive connecting hoses with wind-kessel to the cannula. If the dosing device had been disposed as short-stroke piston or collar in the end of the drug feed hose outside of the container immediately or shortly before the

25 cannula and if said device is actuated from outside said hose, it is possible to solve the problem in a milking-type of motion by periodically applying pressure from the outside of the hose in an electromagnetic construction in a manner such

30 that the moving members in the hose can be omitted. Useful to this purpose is merely a pin carrying an annular ledge within the hose as abutment. Short shaking movements for agitating zinc chloride as addition to depot insulin are necessary

35 for obtaining an injectable suspension. For space reduction the control of a discharge valve is provided in conjunction with a flow measurement.

Differences of the stroke velocity, which are mediated piezoelectrically or by switches to solenoids, or a running back of the motor, which is used for the propulsion of a control gear, safe-
5 wheight for further motors applied for several dosing mechanisms in a considerable manner.
The use of auxiliary fluid instead of the drug for dosing (utilizing the displacing effect) saves or facilitates the cleaning of the dose mechanism.
10 If thereby the auxiliary fluid is brought behind the piston of a syringe for multiple use, so the higher viscosity of the auxiliary fluid hinders its admixing to the drug. Space for the auxiliary fluid can be saved considerably, if a arresting pi-
15 ston is applied which moves up to the separating piston, so that always the same limited amount of fluid swings back and forth between the dose mechanism and the syringe for multiple use.

Solution of the Problem:

The problem on which the invention is based is solved in that one of the cannulas employed to input fluids is also devised as sensor which will, once the cannula is introduced into the body of a mammal, according to the invention, transform physical chemical condition changes in the bodies of these mammals into measuring signal changes fed to a measuring instrument in order to render these physical chemical condition changes visible.

The sensor may be used itself as electric voltage source, the changes in tension or the intensity of current supplied are employed for processing the measuring signals. The sensor may, however, also change, under the physical chemical influence of the the bodily state, its conductivity for electrical currents supplied from outside and to transmit, in this way, metered data to the measuring instrument. At least on parts of the cannula shaft a layer is (or several leayers are), as a rule applied, which layer (or layers) will produce the properties of the sensor. This sensor covering reacts in keeping with the main use or application of the invention, on the cannula shaft mainly with the body glucose in order to react therewith in the manner of an electrical cell or to change, by accumulation of glucose or their reaction or synthesis products (such as glucose, starch or also lower carbohydrate chains) the conductivity via the cannula as a function of the glucose concentration of blood and tissue (depending on the position of the cannula within a blood vessel or in the subcutaneous tissue or in the peritoneal cavity). By removing a part of the cannula shaft behind the can-

nula tip whereby its grinded surface is preserved,
it is possible the shaft wall to be supplemented
by synthetics, its sensor properties having been
imparted predominantly in the electrical insula-
tion from the shaft of the cannula. It may, how-
5 ever, also be placed, for discharging fluid and
with sensor properties on the surface in close
connection to the bore of the injector adapted
piece or -where such is not existent- towards the
infusion hose in such a groove-like recessed can-
10 nula shaft, without it being necessary that its
free end must unconditionally discharge via the
cannula tip proper (with very short cannula shaft
this may turn out, however, to be appropriate to
assure drug injection under the skin). Even though
15 a sensor cannula of this or similar type may ap-
pear to be useful for being applied in the dialy-
sis of patient having renal insufficiency (quan-
tifying the metabolic products retained in the bo-
dy or the water and salt ballance), it seems that,
20 in the possibility for detecting the measured va-
lues over as more extensive period of time the ap-
plication of insulin pumps with lying cannula are
particularly advantageous. According to the charac-
terization in subdividing the cannula shaft in at
25 least two compartments electrically isolated
from one another the advantage obtains that an
additional comparison electrode outside of the
cannula may be spared. Electrical conductors are
suitable located within the infusion hose, over
30 stretches thereof, and connected (embedded in
and isolated by the wall) to the meter. When
using the the sensor cannula for a unique injec-
tion, the opportunity is exploited according to
the invention that the sensor coat of the can-

nula is modified under the influence of products of metabolism, particularly saccharide or more particular glucose, and this irreversibly, the extent of these modifications being used for determining the measuring parameters. In particular glucose can be bound to the coat of the cannula (e.g. to vegetable e charcoal or ferrous conditioned), and it is possible to reduce, by the enrichment of the saccheride being an both conductor an insulator, the conductivity of the sensor coating, being selected as good conductor, as a function of the offer of saccheride with due consideration to the time function.

A further solution is the miniaturization of optical measurements and its transfer towards the region of the cannula. Therefore light is directed against an optical indicator zone through at least one light conducting fibre or directly through the cannula shaft, and light, which is altered reflected by the influence of products of metabolism, is measured and evaluated. An other solution without colour indicators uses polarized light and the property of any products of metabolism (thereby also of the glucose) to alter the polarization plane? dependent from its concentration. The polarized light is deflected according the invention from a medium of other density, which preferably is inserted on the area inside of the cannula tip, after the contact with the product of metabolism and it is compared with a reference ray or an standard of measurements by means of suitable detectors. Keeping within the time span required for measurement and injection is best assured when using the suction-type injector, i.e. when the skin is drawn in, by way of the negative pressure

re of vacuum within a suction cup surround-
ing the cannula, and retained for such period of
time until the suction cup is again (by automa-
tical control) revented. When using suction-type
5 injection, the rim of the suction cup can be al-
lized (e.g. coated with silver silver chloride or
while applying a contacting jelly or an electrode
ring bondable on both sides) as comparison elec-
trode. Instead of the raising of the skin by suc-
10 tion such raising may be performed by plaster-tr-
traction. Termination of measurement and the com-
putation process for updating the dosage to be
dispensed can be exploited as an alarm signal for
the dosage pump. In this way the injection re-
15 lease or tripping by earth contact of the cannula
-advantageous in and by itself- within the skin
as raised up may be dispensed with.
(Depending on an "earth contact", which is in
reality the contact with the body as sender,
20 from the closeness of outer electrical fields,
would have made it necessary to assure the
release via the closing of circuit with the aid
of the skin as conductor, which principle is ex-
ploited according to the invention when the mea-
25 surement instrument fails). It is an essential
part of the construction of the invention to use
compensation of a bad metabolism adjustment with-
in a medically programmed frame over additional
doses of unmodified insulin calculated as favou-
30 rable or by the withdrawal, calculated as favou-
rable, of doses of depot insulin. From the prac-
tice the physician has gained in having his pa-
tient cooperate, the problem arises also to en-
able the physician so as to limit the dispensa-
tion of an arbitrary additive dosis of unmodified

insulin just before planned meals. On the other hand, there are situations in which a program automatism is appropriate which permits, automatically and without any interference from the physician (insofar he does not block this opportunity with patients unqualified in this respect by means of the device provided herefor)

to finally correct erroneous programming and to adapt programming (if necessary, also without the collaboration of the physician) to the modified circumstances of life and of nutrition.

The measured values and the doses dispensed as well as the type of influencing the program as set may be printed out in the apparatus. Moreover, in addition to or in place of a printer one may also provide an electronic storage unit for the measured values (and those of dosing) which may be displayed on the physician's screen or plotted as succinct curves. Even when using a permanent infusion cannula it is advantageous to exploit the opportunity of a single and unique measurement (for determining the initial metabolism condition). Likewise, it is an advance provided by the invention to provide for programming via lock-type rotary contactor rings combined to form program blocks, since they give a simultaneous overview over the point of departure in programming. By means of print-type elevations of the programming symbols and their arrangement to an entire horizontally extending programming line a print-out of the program envisaged in the patient's file or elsewhere can be effected without having recourse to auxiliary technical apparatus. Locking, against inadvertent turning of the contactor disc beyond the snap-in stage or posi-

tion by exerting a lateral pressure by means of
a screwed joint operable with the aid of a key,
is facilitated by a lateral profile formation
on the carrier or support ring mounted underneath
5 of the contactor rings. Between carrier ring and
stop or click-stop ring there is respectively a
sprung-back play in contacting guidance to the
control unit so that desired or control values
-even as modified by sequences of automatic operation-
10 can be rendered visible on the display
unit. Signalling an alert for an imminent exhaustion
of the drug or preparation (or cannulas also),
which can be influenced by the patient, is
also provided so that, under the control of the
15 computer, it is possible to effect replenishing
of a nearly exhausted drug supply with respect
to the final or terminal dosis, allowing in this
way the reservoir to be almost completely emptied.
A lock (electromagnetic or mechanic) permits the
20 patient to override same so as to effect replenishment
himself and to enable him, however to
put off the time setting by replenishing there-
after using a large amount of the drug or preparation.
For those cases, wherein e.g. it would be
25 required, for measuring conductivity, to have
part of the lumen of the cannula also covered by
a coat (to deviate the need of having to enlarge
the cannula diameter -with the imminent risk of
injury), a small amount of the drug (e.g. in the
30 form of a unique volume-reducing base stroke)
has to be provided from the dosing pump or discharge
even prior to the cannula penetrating into
the skin. In this way it is prevented that blood
of tissue fluid will be aspired over the capillaries
35 and that across these capillaries current
will be conducted as shunt. (Provided that the

drug is practically a non-conductor). If finest
hoses and capillaries are used inside of the can-
nula lumen, the injection is suitably begun be-
fore the measurement is completed to limit the
5 time of the contact with the injector. But the
pressure of injection is limited on account of
the violation of tissue. The computer is able
to start a limited immediate correction of do-
sage subsequent to injection of a basis rate.
10 The device for suction injection proper has un-
dergone further developments covered by the in-
vention, leading to a reduction of size thereof
-not at least consequence- so that it is possi-
ble to associate therewith additionally the mea-
15 suring and control unit for the sensor cannula,
and this without diminishing its handiness. Due
to the fact that the vacuum requirement of the
suction cup is relatively small and the human
hand is capable of exerting a considerable con-
20 centrated force, a piston cylinder pump with
pressure spring accumulator remains an economic
method. Yet, to be sure, it is necessary to in-
terconnect in the suction channel a sand filter
between the vacuum pump and the suction cup so
25 as to prophylactically guard against fine quartz
grains from the deterioration of the piston cy-
linder face, as they will be pulled out by
suction from the fine pores of the skin. Opera-
tion of such a pump is carried out, for rea-
30 son of spatial economy, via Bowden wires. Ten-
sioning operation for the spring is apprearia-
tely connected up with the hinge motion of the
cover above the suction cup. The suction piston
is locked starting from the suction cup by wake-
35 ning the break-away force of the spring by means

of a clamping arrangement or of the adhesive force of the permanent magnets. In this way the risk of cogging is decreased when tripping the generation of negative pressure takes place unilaterally and excentrically from the suction cup. The delay effected by this relieving or unburdening mechanism acts favourably for closing a spring-weighted pressure relief valve compensating the air pressure compression arising when the suction cup contacts the skin and when the suction cup is raised towards the cannula. Raising the suction cup rim against the force of the spring and releasing the lock of return movement of the suction cup during reventilation or reventing bring about that there is a distance between cannula and skin subsequent to injection. This same problem can be solved by the use of a central pin centrally raised in the suction cup (on account of the proximity of the cannula advantageously in the center of an eleptical suction cup) and sealed thereagainst during the suction action on the skin, and it being pressed against the skin under the action of the spring during reventing okperastion of the suction cup. Spring tension for such auxiliary functions with concomitant extensive expenditure of force becomes effective when closing a cover slide (having memory function for imperfect availability for use of the device) so that the pressure of the central pin, serving as release or trip of the vacuum pump) on the skin can be mitigated. In general, the feasibility was tested to deflect the pressure of the tripping pins subsequent to rendering the vacuum operational, which pins project thereover, initially, starting from the vicinity of the suction cup rim. This comes

about by the effect of the wedge-type slants
onto a flexible ring unblocking the upward mo-
vement of the pin, with but little friction,
after having passed said wedge-type slants.

5 Resetting movement up to the flexible rings on
the wedge-type slants becoming effective is car-
ried out via an elastic collar annexed on the
suction cup rim, which tripping assures a seal
with respect to the skin. The resiliency of the
10 tripping pins has the effect that the stability
required for the suction cup rim is assured so
that no ambient air may penetrate below the
suction cup rim during the application of suc-
tion. In vacuum preserving or retaining suction
15 cuplœets, wherein suction as required has alrea-
dy been prepared in the industrial manufacturing
process, the relief of said vacuum is transfered
onto a tripping mechanism in the device subse-
quent to the locking during storage, and this
20 by the holding or retaining function of a cover.
Inasmuch as the accumulator or damming effect
of the skin with respect to a valve pin in a
tablet parallel to the cannula has turned out
to be unreliable, this mechanism was improved
25 in that a resilient stay or strap, starting
from the valve pin, projects the suction cup

in the form of an arc toward the skin. The
ends of the stay or strap rest on the rim of the
30 through which air penetrates gradually, after
the suction has been switched off, into the
suction cup. It is also an advantage of the in-
vention as regards the dosing operation in the
quantitative transport of the drug or prepara-
35 tion in the quantitative transport of the drug
or preparation via three valves closed in pre-

determined sequence to have electromagnetical-
ly operated pumps fill hose rings with an auxi-
liary fluid, preferentially via dosing chambers
bordered by perioheral rings and on a pin in
5 the drug hose close to the cannula adapter. Also,
piezo-electric actuators or regulating members
surrounding the hose may be employed as dosing
valve. The operation of a dosing pump for trans-
10 porting a (normally viscous) liquid such as para-
fin avoids that the components of the pump come
into contact with the drug or preparation, thus
economizing on cleaning. The auxiliary fluid or
liquid may also be introduced behind the piston of
15 a step syringe or syringe for multiple use, giving
rise to the effect of a dosing hydraulic system
with forceful and slow advance of the piston
of said step syringe. The piston may be formed of
wax or comprise a wax-type envelope, whereby
20 the expensive sliding fit may be avoided. A par-
ticular coupling valve is comprised of a slide
valve with spring-back action in the component
part of the apparatus and of a slide-type collar
above a lateral opening for the admission of the
25 auxiliary liquid in the step syringe, said collar
being slidably moved by locked action when the
step syringe is inserted into the apparatus.
An air-free coupling of both liquid systems is
assured in this manner. The consumption of space
30 for the auxiliary liquid, mainly, may be saved,
if only an amount which surmounts the
single dosis stroke together with the leaking-
loss, is injected by the dosing mechanism bet-
ween the separating piston and a supporting
piston, and if the supporting piston is led
35 gradually in each case and then is locked ac-
cording to the motion. In such manner the auxi-
liary liquid shuttles between the dosing pump

and the interspace of pistons and the separating piston and the supporting piston move one after the other.

5 With the respect to the generation of the vacuum a type of sluice valve terminating the groove on the mandrel of a pressure gas cartridge is of importance, wherein a seat valve of small dimensions within a plate or disc of
10 a larger seat valve is pushed open, initially with a slight expenditure of force. The highly compressed gas banks up or accumulate then in a chamber which is closed by a slide valve behind the seat valves. On the account of the
15 equalization or compensation of pressure in the chamber it is then possible to push the large seat valve open, and this with little effort. The flow of gas will then stream via the opened slide valve into the gas jet pump. Raising the gas capsule in the mandrel may be effected
20 by means of a swelling pin (e.g. formed of agar-agar) while taking up water. The automatic exchange of cannulas is facilitated by the use of stacking cannulas, in the vertical arrangement in a magazine tube or hose
25 the repectively antecedent cannula shaft has been received in a recess of the body of the following cannula. The feed of the drug is carried out laterally via a ring-type or annular groove in the body of the cannula having a bore opening up into the cannula shaft. At the end
30 of the chamber in said body for receiving the adjacent cannula shaft an elastic septum may be centrally pierced by said cannula shaft. A cut between two cannula body halves may also
35 be provided so as to allow for stocking in bent magazines, about which cut bending action can be effected. Drug feed may also proceed via verti-

cal grooves along the body of the cannula.
bonds or thread-like adhesion between the can-
nula bodies may constitute means for affecting
transport by means of traction which is prefe-
5 rably exerted from the claws, attached at the
end of the cover of the suction cup to a take-
up tube, onto the used cannula sticking out from
the magazine. Pressure action on the stacking
cannulas may originate from compressions springs
10 tensioned by the pushing effect of the cannula
already used when they are slidingly pushed by
hand in the operational cycle magazine. A leaf
spring may be used as tripping or contactor me-
chanism, which spring is actuated by means of
15 a tripping pin on the cover. Raising of the cen-
tral pin in the suction cup will permit, via
spherical snapping means, the cannula to be
stepped down, a process arrived at in this other
embodiment by using the effect of compressed
20 gas onto a sealing piston in the hose of the ma-
gazine(Fig.18,19). Flattening or oval shaping of the
magazine can be exploited as safeguard against
rotation while warranting the effectiveness of
the hinge members between the cannulas a well
25 as providing for an enhanced abutment and sea-
ling effect of the channels wherein the drug
or preparation is conveyed(Fig.27).
To blend thoroughly the components of insulin
within the area of a hose pump which is driven by
30 a spiral spring at least one peg fastened on
a disk on an axis of this pump is moved by means
of a second spiral spring over a gear-like
uneavenness of the opposite face of the disk
which bears the rollers of the hose pump so, that
35 it will be caused a jerky and repeated eva-
sive movement of the hose pump against a spring.

The precision of dosing by small circumferences is increased by this means thus two hoses are parallelly led over two identically working hose pumps, further by this means thus the hoses may be capable to extend only between the excavations of the disks which bear the rollers within the pump, further by this means thus the sector of hose between the pump and the cannula to which they are reunited for example, is surrounded by a solid cover to diminish the windkessel. Still a better solution is brought about by the insertion of a small piston pump immediately before the cannula attachment piece, whereby that effects the drug delivery either by the coulisse of a disk driven by spring power by functioning of a solenoid which is repeated equivalent to the dosing. The bearing of the piston pump within the drug hose when actuating it from the exterior by way of a cross plate at the pump rod eliminates the necessity of cleaning and facilitates the exchange of the dosage system in keeping with the objectives of the invention. Particularly advantageous for keeping the costs of production low is the replacement of a cylindrical piston by an elastic collar the cavity of which is being pressed against a contact surface by means of a rod so as to deliver the dosis, with surface is the contact surface of a transpierced plug laterally welded to the hose, the end of the rod passing the bore of the plug being enlarged and closing with its reciprocating action the plug bore towards the cannula attachment piece. It is possible, in a particularly advantageous manner, to eliminate also the pump housing when the plug (114) is directly introduced into a hose enlargement such as plies of fabric by vulcani-

zation, whereby the hose enlargement is only limited capable to expand inside of the axis bush of the injector(Fig.92). The motor of the dosage device assumes here, additionally, the function of the vibrator for thoroughly mixing the drug or preparation and prevents a permanent squeeze on the hose by means of the pump rollers; which squeeze will continue to constitute a problem even when, as shown in the example illustrated (Fig.65), pinching or squeezing the hose by the rollers always in one location will practically prevented by running the rollers in one direction while adding therto the dosage paths, and this with highly probability. To have but one hose between the encompassing recesses of the support or carrier disks for the dosage rollers prevent the hoses from the extending within the pump, which is compensated additionally by means of spring action at the end of the hoses emerging from the pump. Another variation is to radially dispose two roller pairs each one above another in such a manner as to enclose the hoses therebetween(Fig.73). Likewise, in other variation, it is possible to counteract the traction of the rollers by providing for a fixation of the hose pair via a cross stay between the hoses, which cross stay is in the form of a rope ladder spaced for a fixed gear ring(Fig.74). For the storage of the supply of the drug or preparation an easily contractable thin-walled membrane, i.e. a simple bag, was used for reason of simplicity. Since, however, drug feed by means of pressure exerted in a container or vessel substantially facilitates dosage operation free of air bubbles (it is possible for air also to penetrate under partial vacuum from the cannula into the hose or flexible tube system, or it may also be

the case that a return suction effect sets in via the cannula in the direction of the somal tissue). improvements were carried out in this respect also, and this in such a manner that this pressure
5 onto the supply of the drug is effected uniformly from the very outset complete exhaustion of the drug supply. This is effected by screwing down the cap or cover towards the bellows conveying the
10 the doses of the liquid medium dispensed(Fig.77). In such a way a crude dosing, similar to the use of a step syringe, is effected which is, however, supplemented by the reciprocating or piston pump for fine adjustment dosing. In a second example
15 using compressed or pressure gas padding(Fig.81) this effect is obtained by the delayed release of carbonic acid gas by having diluted hydrochloric acid react with calcium carbonate, the latter provided on a polyethylene foil may be protected
20 by a pectin film which is gradually decomposed by said hydrochloric acid. A pressure control valve prevents at all times that the pressure will rise excessively. The reservoir or supply cylinder receiving the bellows may suitable be a constituent
25 part of the device, while the bellows containing the liquid drug or preparation will be replaced or exchanged. For the production of carbonic acid in an amount, which is necessary for the expulsion of 50 milliliter of liquid at a reserve pressure
30 of 1 atmosphere overpressure, 375 milligram sodium bicarbonicum and 815 milligram hydrochloric acid of 20 percent. If calcium carbene is used therefrom 446 milligram would be necessary. To connect with the foil the heat-resistant calcium
35 bicarbonate should be prefared, because it may be blown heated over a foil or it may be scattered

on a polyethylene foil which is heated of
100 until 120 ° Celsius.

A precautionary warning or alert indicated before
the drug supply is used up is effected, in keeping
5 with the invention, by a gradually lowered screw
cap or cover -which is visible by inspecting the
slot of the cylinder or the dosing scale- encoun-
tering a removable obstacle inserted there at a lo-
cation of the lower limit level sufficient for but
10 one sole dosis before exhaustion of the supply
(Fig.77). Alternatively, it is possible also to
mount, in particular within the pressure gas sup-
ply bottles(Fig.94) hardly inspectable, a thread
between the bellows and the cover, which thread or
15 yarn will actuate the alarm when tightened just
as in electronic musical cards triggering the tu-
ne or melody. Finally, the drug consumption may
also be monitored by electronic computation
(Fig.92), or it can be read(Fig.93). In this re-
20 spect, a pre-alert range may be selected and the
injector may be prevented from functioning when
a rest amount is found to fall below the quanti-
ty required for a single dosis.
Many improvements have been provided for operatio-
25 nal control. Thus, in the solutions presented with
spring mechanism -as with the hose pump- control
simulation means for triggering the injection or
reventilation simultaneously with the insertion
of the vacuum reservoir is biased. Consequently,
30 it is not necessary to actuate, in a cumbersome
manner, some particular lever; rather, positio-
ning or controlling elements are provided as
pins projecting downwardly from the cannula
attachment piece. Three pins are located
35 in ports outside of the clover-shaped suction
cup rim(Fig.85), thus enabling the releasing or

tripping pins to approach increasingly the center of the device, without diminishing its adhesion on account of a reduced skin contact surface. Pins housed within the suction cup must be sealed relative to the suction cup roof(Fig.22). In the example illustrated, these pins will, firstly, effect rotation of the ring against the action of spring so as to move upward at low friction(Fig.79). By means of this rotation of the ring pins moved from the opposite direction will engage apertures in the ring and the lowering effected by manual pressure enables the valve between suction cup and vacuum reservoir to be opened. In the example discussed, the negative pressure or vacuum is generated in three chambers of same volume disposed annularly about and above the suction cup(Fig.82), viz. air dispersed by means of electrical resistance or heating wires over the mains. Heating the chamber is shut off via a temperature sensor (e.g. a bimetallic switch) or a time interval switch after the highest temperature has been reached, whereupon the chambers are cooled. Resilient flap valves permit the out air to leave the chambers via the suction cup, serving -by way of secondary effect- also as cleaning means, while the pins acting as levers move one of the respective flap valves from above and for the purpose of air pressure compensation between chamber and suction cup from their seat. Inasmuch as a broad rim in the form of the brim of a hat around the suction cup edge is useful at all in order to prevent an injector of elongated construction from being tipped or canted on the skin as well as from having air inadver-

tently introduced into the suction cup, the increase of space required for the heating chamber is not so significant when confronted with the savings accruing from the industrially evacuated cuplets about the separate or individual cannula. Dividing the annular shell about and above the suction cup into three separate chambers permits the injector to be used three times subsequent to each effected heating. The vacuum reservoir cuplets were also considerably improved. Thus, a membrane cover or cap about the cannula aperture cone permits, subsequent to loosening a support of the cannula, or the pin(Fig.65,88) due to injection moulding of the cannula, a deeper immersion of the cannula into the skin to the extent of the portion of the cannula shaft or shank located in the reservoir. In other embodiments the suction cup is formed by an injector collar made of rubber elastic material(Fig.77), into which the vacuum reservoir is slid in sealing relationship thereto. A twin-chamber storage system of this type, wherein a distinction exists between the space of the reservoir and that of the suction cup and wherein the cannula projects without being covered, resembles hence a store of reservoir of a single-chamber system having the cannula in its entirety and up its point located behind the terminating membrane. The clearance space about the overhung portion of the cannula shaft may be reduced while economizing on suction so as to be taken up by a annular piston. It is possible to suppress a special valve between suction cup and vacuum reservoir if an extensible membrane is used as partitioning wall between the annular piston and the vacuum reservoir;

such a membrane being possible a foil strip as commonly used in a household (Fig. 77, 84). In this case, however, the cannula piston must be arrested prior to use from moving towards the vacuum reservoir. It is provided, according to the invention, with a transverse slot into which, starting from a retaining collar or from off-shoots of the cover, holding tabs extend from the lower margin of the vacuum reservoir into said transverse slot, thus preventing prior to use and under the effect of the vacuum the inward motion of the annular piston. Retaining pins or lamellas, which assume -subsequent to the removal of the holding collar of the suction cup cover- the function of retaining the annular piston up to the point for triggering the injection, snap into engagement in sections of the annular transverse slot between the holding tabs when inserted into the injector.

With respect to manufacturing, the expensive transverse slot can be replaced in that in the same form or mould with the vacuum reservoir an annular piston is manufactured having an open annular notch. It is then conveyed by a revolving transport system to a sticking device, e.g. an ultrasonic welding head, and then united with a circular stretch-foil. Subsequently, the annular piston is conveyed below a vacuum reservoir cuplet and the borders of the circular foil are bonded to the rim of the vacuum reservoir. This rim is shaped in keeping with the invention so as to constitute a broad brim of a hat, and this rim may simultaneously have a linear sealing contact with the suction cup collar of the injector. The transverse slot and the annular notch, respectively, may be constructed in alter-

ning sectors either horizontally or obliquely so
as to contribute to enhancing, on the one hand,
the locking effect of the cover tabs or the col-
lar pins and, on the other hand, however, to con-
tribute to facilitate unlocking the holding or re-
5 taining pins or lamellas of the injector(Fig.84).
Due to the fact that the cover of the vacuum re-
servoir is rigid in this embodiment, the approach
of the cannula, when in use, is effected -in addi-
10 tion to the skin being raised- by the resilience
of the suction cup collar. Increasing the clea-
rance of motion between skin and injector may
serve the purpose of relieving the vacuum effect
on the skin within the suction cup, but also, on
15 a subsequent section of operation, of triggering
the dosage device for injection. In the example
of Figure 65 the correct vertical guidance in the
movement of the injector towards the skin is a
prerequisite for actuating the triggering opera-
20 tion in that raising the suction cup sollar can
only be effected simultaneously with a cylinder
segment raised and which comprises, towards the
outsinde surface of the cylindrical accomodation
for the vacuum reservoir, a snugly fitting ring
25 which locks against the wall of the accomodation
when guided unilaterally in its motion. In this
way is assured that the injection is triggered
or released only subsequent to secure contact,
a contact supported by vacuum, of the suction
30 cup with the skin. In the example of the Fig.81
the release or triggering of the rotary pumps is
effected only after the vacuum effect on the skin
has been ascertained, just as has been disclo-
sed in previous patent specifications of Appli-
35 cant. In this instant a feeler is used as "suc-
ton switch". This feeler controls modifications

of the shape or form of a membrane or diaphragma
to be lowered prior to injection. A circumscribed
elastic portion is drawn inwardly under the in-
fluence of the vacuum of the reservoir; once
5 the vacuum has been decreased by due compensation
with the suction cup space or chamber this mem-
brane lifts up slightly. The exploitable effect,
however, very small. For this reason, a sliding
valve, operating at low friction, has been pro-
10 vided as connecting or tripping element. The fee-
ler associated therewith is, to begin with, advan-
ced by means of a pneumatic piston towards the
elastic membrane operated by the bellows which
is compressed when the vacuum reservoir is inser-
15 ted in the injector and which remains in said
compressed state until such time as the space
above the sliding valve has been reventilated.
The re-expansion, perhaps reinforced additionally
by an auxiliary spring, of the bellows actuates
20 the connecting or tripping element for the fur-
ther functioning of the device(Fig.75). A slight
marginal projection of a bonded cover membrane
may afford resistance for a resilient holding de-
vice, thus eliminating the need for an expansive
25 transverse groove. Contrariwise, wedge-shaped
means acting laterally on the cover may be useful
for removing the vacuum reservoir subsequent to
use(Fig.69).
A single chamber system will, once more, become
30 economically feasible when the expensive release
mechanism for the suction cup cover supporting
the membrane is transferred to the injector proper
(Fig.86). An extensible elastic membrane bridges
over a bottom ring within said vacuum reservoir
cuplet. An inner portion of said bottom ring is
35 bonded together with an additional annular cover
ring lying with its rim on the lower rim of the

vacuum reservoir cuplet and preventing, subsequent to the evacuation of the latter, the bottom ring to be raised for so long until a border strip of said cover ring along a predetermined breaking line is removed by pulling downward.

5 As duly intended, this is effected first after, initiated from the injector, pins or stop segments, at the level above said inner conductor cylinder at its border and passing through thinned

10 out wall ports of the vacuum reservoir cuplet, assume the support function of the bottom membrane. In the single chamber system the cannula, as a whole, is located protectively behind the cover membrane, the disadvantage of a truncated cannula

15 tip is of less concern in the membrane passage in the formerly utilized rubber membrane than in the highly elastic synthetic sheet foil. The condition, that after opening the membrane lock by the cannula attachment or adapter piece of the cannulas, the vacuum of the reservoir will become

20 effective thereinto can be exploited to the effect to render the negative pressure or vacuum laterally visible by collapsing an elastic small ball. If, in the case of deeper injections, the cannula of elongated construction destined for

25 such depths will hit upon a blood vessel, the small ball or sphere will fill up with blood once the clamp(210) has been loosened or detached. A faulty injection into the blood vessel may thus

30 be prevented by interrupting the injection(Fig.86). The single chamber system is provided with the largest vacuum storage space with respect to the overall dimensions of the vacuum reservoir cuplet. Also, the sterility of the cannula is safeguarded

35 even without being externally wrapped or packed. The functional control for reventilation the suction cup has been improved upon in that an easily

actuable sliding valve is being closed, firstly,
with energy accumulation for the return of the
valve rod, prior to actuating the dosage device.
The valve reset mechanism is, however, blocked
5 until the dosage mechanism has run full course,
the reset mechanism being actuated by the deflec-
tion of a mobile stop element at a steep flank of
the connecting link guide at the housing(Fig.68,
Fig.76, Fig.80). In this manner the risk of reven-
10 tilation even prior to the dispensing the amount
total of the liquid drug preparation and also the
risk is obviated that during the withdrawal of
the tip of the cannula the preparation might be
15 injected through the upper layers of the skin also
therein, i.e.intracutaneously. The thorough mixing
of the constituent of the drug or preparation may
also be effected in that the buzzer of the elec-
tronically controlled alarm system is coupled me-
chanically with the hose sections supplying the
20 preparation in such a manner that its vibrations
are communicated to the interior of the hose or
tube(Fig.90), and this shortly before the injec-
tion is carried out. The peripheral or border ring
(223) at the vacuum retaining cylinder or reser-
25 voir cuplet(5) is well suited both to provide for
a better attachment of the border membrane(6) and
for a more adequate seal towards the injector
(Fig.84).

On the field of the dose mechanism it is proposed
30 to effect dosing by means of a magnetically clock-
actuated rocker switch, if there is a correspon-
dingly strong and resistant drug hose (e.g.made
of silicone). The type of clamping hinders the
feed from the container while the hose is squee-
35 zed (e.g.also within a metering screw of worm
the winding of which are constricted or narro-
wed progressively on after the other about, the

hose, flattening off the hose(Fig.98). The possibility to let working the expansion of a body as a pressure donator (either it may be solenoid stroke or piezo-effect) in steps to a part of hose, permits as means for dosing at the same time the shutting up or locking of a afflux leg towards the hose chamber saving thus a valve (Fig.100). It was already discussed above the possibility to alter the velocity of solenoid stroke or piezo-extension (by erratically switching in addition of independent lamellas) and to exploit this for a commutation to an other kind of drug(Fig.97).

The flow measurement (e.g. with clocked actuation of the drug outlet valve- which may also be presented by hose ring constriction or piezoelectric shutter lamellas, to which pressure is applied, about an elastic pin in the hose in the manner of an central shutter of a photographic camera-) may be taken into consideration in connection with a critically high rate of flow or a constant drug pressure in the supply container or also the exploitation of the formation of the electrical field during flow, and this to effect to arrive at a dosing mechanism of reduced dimension. At present, the use of piezo-elements, although in its length extension well maneuverable, seems only possible in connection with mains due to the fact that high voltage is necessary.

It may be decided, in any case, only by considerable expenditure following the prior art until this time, which composition of functional parts realizes the injector according the task or aim.

Since the application of PCT/DE85/00313 any new but essential particular perceptions and embodiments of the invention are gained which perfects it and, even, expands the scope of the invention. The experiments has shown that venous blood vessels can be sucked on the suction cup - in certain cases, p.e. if the skin extends immediately over bone-, then situated near to the upperst horny skin layers. If cannulas with long shaft are used -as it's the case in vacuum reservoiri cuplets (as described above)- the cannula may penetrate the blood vessel completely the insulin or drug being emptied beneath and exterior the blood vessel within the subcutaneous tissue. But if cannulas with short shaft are used, as preferable applied in full automatical and electronically controlled injectors namely as stacking cannulas, the danger of inadvertently injection into a blood vessel is irresponsible big. The control of the seat of the cannual tip by applying negative air pressure before the injection is'nt an ideal solution of this problem because the subsequent reventilation does not avoid needless blessure and, mainly, because an immense mechanical expenditure. The solution given by the new embodiments is that light (or similar rays, preferably laser) is projected through the skin knob which is elevated by suction or traction, and that the difference of light extinction is evaluated as to check wether a blood vessel is contained in the upper subcutaneous tissue under the skin or not. Preferably this is done by at least two light sources with an angle shifting of 90 degrees about the skin knob. If the light, received by the sensors of both (or more) positions is attenuated, a stop signal is generated; it reaches the reventilation valve before the tip of cannula has pierce' the top of the skin knob. A warning signal may be

given by the control unit in order to repeat the injection procedure at an other place of the skin. Instead of the diascopic measurements also a reflexion measurement may be used to check the position of vessels beneath the inside of a skin knob. The other main task of this extension of the invention is concerned with the optical measurement of the skin such as the determination of its thickness as well as its density of capillary vessels or its contents of blood. Such parameters are important for a determination of the state of metabolism especially for the glucose measurement using the change of the plane of polarized light and this preferably by diascopy. The skin knob such as produced by negative air pressure inside of a suction cup or by plaster-adhesive traction or by both methodes is optimal suitable for such measurements because the raised skin is bloodless and therefore pale and transparent(likewise), for about two seconds, and than the skin looks red by a big hyperemie for longer time. The difference of measurements during both states of the skin, this means at least two subsequent measurements, allow the calculatory determination of blood sugar. In such a calculation the skin thickness -equivalent to the way for the ray- and the density or respectively the number of capillary vessels can be included. This task is solved using the change of light absorption by simultaneous measurements along a type of vertically arranged light guide ledge (containing at one side equally spaced fibre ends of detectors in relation to a light source ledge opposite) or by subsequent measurements at a few sensor points with comparation of the alterations at regular time intervals. The diaphanic measurement inside of a suction cup seems to be advantageous in such a manner as to apply also it also in connection with insulin pumps -beared on the body or implanted- perhaps with radio control without the use of a cannula inside of the suction

cup. Instead of the use of visible light also
other wave length could be usefull (p.e. meas-
urements by infrared light). Finally, a light
source may be omitted, if temperature sensors
5 are used to check the distance of blood vessels
or the plethora or fullnes of blood by compari-
son of the measurement values immediately after
the skin is sucked on and a few seconds after
this time. By regularly photometry of thermome-
10 try the possibility is given to check the con-
tinuous skin contact and to interrupt the injec-
tion in case of an intended or unintended reven-
tilation of the suction cup. The last described
electro-optic devices or device (because all func-
15 tions may be exerced by one single measuring ar-
rangement) can be employed as a facultative sup-
plement of a mechanically conceived suction in-
jector as it is ameliorated for a completing de-
monstration of the principle of suction injec-
20 tion. On the field of control technic the circum-
stance was taken into consideration that the skin
creeps comparative slowly into the suction cup.
The previously described "suction switches" for
launching the injection are not enabled for such
25 injectors using cannulas with short shaft and,
generally, the fixation of the pressure loading
for such suction switches was difficult. In this
point, the amelioration consists in a suction
switch -showed as a membrane switch resuming to
30 such a device from 1974- which communicates by a
channel to an area between the outer suction cup
rim and the inner sealing edge or zone. When using
a limited amount of suction, as advisably with re-
gard to the weight and dimension of the device, the
35 raised skin leans against the inner rim or wall zone
of the suction cup. On the other hand the space be-
tween the inner sealing zone (shaped elastic or
large and constituing a kind of new suction rim)
and the sharp outer suction rim is reventilated.

This is done through the fine wrinkles below the outer suction cup rim resulting from the traction which is exercised against the skin outside the suction cup. This reventilation after the suction phase generates a signal which the new suction switch transfers for launching the dosing device. In the field of suction production with respect to the domain of storing and freezing the negative air pressure a new embodiment consists of vacuum reservoir cuplets each having a cover fastened by a central bush letting through the cannula tip. This cover has lateral projections which abut upon inside projections of a ring which is welded with a rim of said vacuum reservoir cuplet. Inside of the suction retaining space of the injector there are triggering bars which work, in keeping with the invention, against the projections of the rotary cover causing their rotation. When the abutment of the projections is dropped the annular piston can be lifted by the influence of negative pressure. Thus the problematic and cumbersome operation of the removal of a abutting covering along a breaking line is not necessary any longer. The boundary membrane between the outer air and the vacuum store is built by a tensile strengthened roll membrane. The locking of the piston movement by the effect of outer air pressure on said roll membrane (causing friction) is prevented by a cover membrane which can be stretched and which closes the small slit between annular piston and cuplet wall. In the above mentioned preferred example of mechanical injector -developed thus from Fig. 77- was returned to a self-triggering mechanism of the vacuum reservoir cuplet. The new example is exercised as a type of three-chamber cuplet which is a kind of combination between the single chamber with the twin-chamber type. Now they are two membranes extending from the annular piston to the cuplet cylinder. But the outer and abutting or

supporting membrane consists of a tensil strengtn-
ened foil p.e. made of aluminium, while the inner
membrane is elastisch or easily to stretch. The
central bush -surrounding the cannula tip- covers
5 said outer membrane by its disk with a thoothed
cutting edge facing to said outer membrane. Behind
the latter extends the the second yielding or elas-
tic membrane between the bush and the cylinder wall.
The smallest damage or demolation of said outer mem-
10 brane caused by pressure against said covering disk
-even it may be a small tear at the attachment line
toward the central bush- effects the raising of the
bush supported by pressure of the outer air towards
said yielding or elastic membrane (the latter there-
15 by works similar as a parachute). Thereby the outer
membrane is cutted open along its outer circumfer-
ence by said cutting disk. The raise of the skin
together with said disk may be facilitated by a skin
adhesive couting of the latter. For the reventila-
20 tion a new variation of mechanism is decribed by
Fig.112. After the dosing movement of the dosing
disk with annular wedge profile ridge or ledge has
finished the spiral spring drives a cross-beam as a
clearing of motion permits by a cam follower in a
25 slot of said dosing disk. This cross-beam again
drives a bush, which descends carried in three ob-
lique slots taking with it three rods (fastened by
in horizontal direction running slots of said bush
and vertically guided). In such manner said three
30 rods, equally spaced about the outer suction cup
rim, are pushed downwards touching the skin. They
adjust the distance to the cannula tip while the
skin is solved from its sealing seat against the
inner rim or sealing zone within the suction cup
35 reventilating the latter.
In the prefered example of Figure 112 the vacuum
reservoir cuplet is taken up in a central accomo-

dating bowl as to insure the large abutting plane of the injector avoiding a repetitive support plate ring. For the removal of used cuplets a special dropping mechanism is affiliated, operated by a over-stroke with the help of a over-taking mechanism during rotating the adjusting ring which serves for the automatically preparation of all functions of the injector. Further means to prevent an unintentional premature re-ventilation by toppling over of the suction injector axis is an over beaker enveloping the injector and joint by a spring. Such an over-beaker permits (owing to the profile assimilation between injector surface and the bottom side of the over-beaker) a firmly pressing on the suction cup perpendicularly to the skin. If the manual pressure is partly diminished said spring helps to separate both parts of the injector. It works as a joint which prevents to manual angular movements. The same effect is caused by a spring connection between the longer upper part of the injector, serving as a grip, and a lower part mainly consisting of the suction cup.

On the field of the dosing mechanism the hose integrated pump is ameliorated and propped by a more favourable drug afflux. Instead of the uneconomical gas blowing off by a pressure relieve valve the gas, produced by joining the proper chemical components, first is introduced in a separated reservoir (p.e. the outer part of a double walled cylinder) wherefrom it passes a pressure-regulating valve towards the elastic drug container. The pump, itself, has a calibrated measuring chamber surrounding case-like a spindle whose stroke closes in a first phase by solenoid or rotated profile ridged or edged disk (handling to the pierced plate or disk enlarging the hose)

the afflux towards said measuring chamber while
letting open the outflow towards the cannula. This
is effected by a well determined gas pressure
bolster near the pump chamber und working against
5 the outern wall of the hose. In a second stroke
phase the dosing spindle is lowered. The outflow
is hereby closed and the drug or preparation
fills the space about the dosing spindle urgend
thereby the hose wall towards the pump case,
10 provided that the gas pressure from the drug
supply container dominates the pressure of the
gas bolster. In the case of the prepered mechanical
inject of Figure 110 to 114 the warning and
blocking mechanism against the exhaustion of the
15 drug is also varied. The axis rod of the dosis
spindle, which also serves with its acuated lower
end to open the sealing membrane of the drug inlet
of the vacuum reservoir cuplet, has on its upper
end a button-like enlargement wherinto a accomo-
20 dating bore with snap-springs engages; said bore
being centrally positionded on plate of the niche
of the folded bellows (serving as drugcontainer).
When the drug supply is nearly exhausted the
upper end of said spindle axis enters into said
25 bore and is arrested there and this happens for all
functions of the injector.
Besides, is proposed, an amelioration of the do-
sage hydraulic within a step syringe. Inside of
the separating piston boundary to the drug at
30 pump cycles a little dosing piston expands driven
by a solenoid which is incorporated to the piston
assembled parts and which is lowered while the
drug is emptied in whole. The supporting piston
is blocked by sideways projecting peg (likewise
35 operated by the solenoid) before the stroke of
the little piston displaces the predetermined

dosage unit through the cannula. In a second example (Fig. 116) the locking of the motion as well as the replacing of single doses is brought about by blowing up the sealing hose ring about the separating piston which measured equal doses of an auxiliary fluid similar as in Fig. 46. Because the function of blocking for the piston movement also is overtaken by said hose ring a separated supporting piston is omitted. A reflux of drug during the retraction of the little dosing piston must be avoided by a nonreturn valve. Preferably, as such serves a hoslet inside of the cannula shaft -curved to a double setting or clapped inside- which is unfolded by the drug pressure lengthening thereby the outflow channel onto the subcutaneous tissue and the surface for the sensor coat, if any needed. Finally, the change between drugs, if only two types therefrom are provided, may be brought about by one motor in driving the one dosing pump exclusively in one direction whilst the other direction is ineffective by means of a ratched wheel and pawl. After electrically pole changing the motor runs back driving the other dosing pump while the first named dosing pump stands still, because its axis has also a ratched wheel and pawl working in the counter direction. A special change-speed gear may be unnecessary in such a manner. At this moment, the developing range is exercised of the control of metabolism using suction (or traction) against a bound skin party producing a knob and evaluating measurement data to equalize disorders of metabolism preferably by the administering of insulin by a minurized device or devices. A measuring tape gradually divided and fastened to the upper part of the folded bellows with drug may be rolled down behind a window of the cover of the injector whilst said folded bellow is lowered to empty the drug for injection.

Short Description of the Drawings (Examples) :

Figur 1 shows in a top view a filled injection syringe with sensor cannula which is connected to a measuring device.

5 The Figure 2 shows in the longitudinal section a vacuum reservoir cuplet which preserves negative pressure with sensor cannula connected with a dosing instrument operating by hand.

10 The Figure 3 shows in a side view an insulin pump connected as well with a sensor cannula as with a measuring device.

Figure 4 shows in an longitudinal section -to the rihgt hand also in the cross-section- the detail of a cannula adjusting piece which is con-
15 nected with a coupling piece for the hose.

The Figure 5 gives a block diagram for the date storage and the date reading at a device according to Fig.1 to 3.

20 The Figure 6 gives a refinement of the block diagram of the Figure 5.

The Figure 7 shows a circuit diagram of the reader of a device according to this of Fig.5 and Fig.6.

25 The Figure 8 shows in a natural size the housing cylinder whith its derivating hose and the folded bellows and the supporting shell serving to the inserting cylinder in the longitudinal section except for a shortening of about 40 millimeter.

30 The Figure 9 reproduces the inserting cylinder which is able to be introduced into the housing cylinder of Figure 8 furnished with a maximum filled injection syringe in a logitudinal section.

35 The Figure 10 shows in a cross-section along the iron plate which closes upwardly the inserting cylinder whereby the position if the six permanent magnets and of the actuating tube for the reventi-

lation valve is drawn in with dotted lines.
The Figure 11 shows in the longitudinal section parts of a housing cylinder similar to this of Figure 8 whereby the features of the reventilation valve is modified.
5 The Figure 12 shows diminished about to the scale 1 : 5 an water stream pump joined to the pipe in the longitudinal section suitable to the operation of the device.
10 The Figure 13 shows a longitudinal section through an injector which is operated by a CO₂-gas-pressure-capsule suitable for on kind of medicine with automatically change of cannulas.
15 The Figure 14 shows an cross-section in the Height of line A - B of the Fig.13.
The Figure 15 shows a cross-section in the Height of line C - D of the Fig.13.
The Figure 16 shows a longitudinal section through the detail of one of the both coupling valves for the liquid for Fig.13.
20 The Figure 17 shows a cross-section through the yet-pump of Fig.13.
The Figure 18 shows on the left hand side in the longitudinal section and on the right in the cross-section a detail onto the end of the cannula magazine in a scale 5 : 1 for Fig.13.
25 The Figure 19 shows a side view towards the lid of one side referring to Fig.13; to the right of this a vertical-section and below a cross-section in the height of line A - B is represented.
30 The Figure 20 shows in the vertical-section along the line E - F of Fig.13 details of the steering for the release and the change of the dosage. Under that a cross-section is shown.
35 Figure 21 shows in the scale 2 : 1 details

of the Fig.20. Under that shown again a cross-section along A - C. At right hand details of the position of the overcoming spring of the trigger is perceptible with two views which are turned for about 90 °.

5 The Figure 22 shows in a partial view above and below in the longitudinal section and in the middle in the cross-sections A - B and C - D details of the steering mechanism.

10 The Figure 23 shows the steering arms, which extend from the half-conduit and the lid slides, which are operated from these, with counter and blocking mechanism in a partial

15 diagram in the longitudinal section and under said in a over-view. To the right hand yet a vertical section is demonstrated.

The Figure 24 shows in the longitudinal section the counting and blocking mechanism according the Fig.13 and the following.

20 Under said lies the cross-section in the height A - B.

The Figure 25 shows in a scale 5 : 1 the detail of the transposition of the stroke-moving of the counting mechanism to the turning.

25 The Figure 26 reproduces in a winding up with the scale 5 : 1 the grooves inside of the guiding-bush.

The Figure 27 reproduces on the left in a longitudinal section and on the right of said in the longitudinal section also in a scale 5 : 1 a cannula magazine and variations of stack-cannulas.

30 The Figure 28 shows in a scale 10 : 1 on the left in a longitudinal section and on the right in two cross-sections of different height
35 a dose pump for the auxiliary liquid.

The Figures 29 shows in the longitudinal section an electrically driven injector with syringes for multiple use for two different medicines.

The Figure 30 shows a cross-section of the Fig.29 in the hight A - B.

The Figure 32 shows a wiring diagram in TTL according Fig.29,30.

The Figure 31 shows in the longitudinal a variante according to Fig.29, which have a motor with a control gear for two dosing hose pumps.

The Figure 33 gives a TTL-wiring diagram of the Fig.32.

The Figure 34 shows a medicine supply bottle with pressure gaz inside of a folded bellows in the longitudinal section.

The Figure 35 shows in a longitudinal section through a medicine sac inside of a sac with pressurized gaz.

The Figure 36 a schematical over-view of a suction injector as a preferred elaboration of the invention. Inside of the magazine hose the stoo-ring of stack-cannulas of two different constructions is presented in the longitudinal section.

The Figure 37 shows a longitudinal section through the suction injector, which follows to the line F - G of Figure 36.

Over the suction cup a cross-section through said (the hight signed by an auxiliary line) and is perceptible and on the right a cross-section downwards from the suction piston.

The Figure 38 shows a over-view to the roof of the suction cup and additionally the cylinder(304) with the cannula magazine.

The Figure 40 shows a schematical longitudinal section along the line C - D to explain the me-cnaism of piston-guidance and of the movement of the suction cup lid during the waiting position

before the injection.

The Figure 41 corresponds sweepingly to the Fig.40, but it shows the stage after the injection.

5 The Figure 42 shows the stage after the closing of the lid.

The Figure 43 shows a variation of the trigger mechanism for the suction piston whereby the line of the longitudinal section follows to such of the Fig.26; the suction cup is presented in a side-view.

10 The Figure 44 shows in a schematical longitudinal section a possibility of connection between the old and the new supply sac for the partial fillingup of the old.

The Figure 45 shows above in the longitudinal section and below in the cross-section two dosing pumps for the injector as in Fig.26 and following and a bolting device of the supply bags.

20 The Figure 46 shows in the longitudinal section in the scale 5 : 1 the detail of a dosing pump in connection with one of the magnetic driven dose pumps.

The Figure 47 shows schematically the running up of a peristaltic dosing movement on a variation of the arrangement of the pumps to saving dose pumps.

25 The Figure 48 shows in a longitudinal section in the scale 5 : 1 a stack-cannula according the Fig.25.

30 The Figure 49 relates sweepingly to the Fig.48 and is a variation of cannula.

The Figure 50 shows in a longitudinal section and under said in a cross-section along the line A - B in the scale 5 : 1 a special sensor cannula in wich the shaft is partialy replaced by plastic material.

35 The Figure 51 shows a cannula with a inlayed sensor tube or sensor thread while the shaft is intact
40 which cannula relates according to the description

to the Fig.50.

The Figure 52 shows a variation of a cannula with inner coating in the longitudinal section and in the scale 5 : 1 .

5 The Figure 53 shows a cannula, which corresponds according the manner of representation, to the Figure 50, whereby a little hose is put in the cleft shaft.

10 The Figure 54 shows in the longitudinal section in the scale 10 : 1 a sensor cannula for the reflexive photometrical measurement.

15 The Figure 55 shows in the longitudinal section in the scale 10 : 1 a sensor cannula for optical measurements with light conducting fibres, shown only as far as the shaft attachment.

20 The Figure 56 shows in the longitudinal section in the scale 10 : 1 the variation of a stack cannula corresponding to Fig.48,49 inside of a booring of the device, whereby the light is feeded by a swivel segment.

25 The Figure 57 shows above in the longitudinal section and above in the cross-section the arrangement of the rotary contactor rings on a cylinder of the device for a contrivance according to the Figures 36 and the following.

The Figure 58 shows a functional diagram for an electrical control and programming.

30 The Figure 59 shows a program operation which is controlled by a processor for an injector according Fig.36 and following.

The Figure 60 gives a afinement of block 6 from Figure 59.

The Figure 61 is a continuation of the Fig.61.

The Figure 62 is a continuation of the Fig.61.

35 The Figure 63 is a continuation of the Fig.62.

The Figure 64 is a continuation of the Fig.63.

The Figure 65 is an illustration of an embodiment of an injector having two parallel and

identically operated hose or tube pumps as dosage device and comprising a supply bag having highly flexible walls and a vacuum reservoir cuplet of the twin-chamber type as vacuum source; this embodiment together shown in a longitudinal sectional view.

The Figure 66 is a cross-sectional view of the mechanism(A - C) of Fig.65, showing dosage preselection for three respective applications.

The Figure 67 is a cross section C - D of Fig.65, showing the dosis counter with locking means.

The Figure 68 is vertical section E - F of Fig.65, showing the release mechanism for reventilation and for dosage dispensation subsequent to the termination of the vibratory operation.

The Figure 69 is a cross-sectional view G - H through the upper region of the vacuum reservoir cuplet of Fig.65 with the mechanism for holding the latter in the injector as well as a mechanism not represented in Fig.65 for removing the same.

The Figure 70 is a cross section J - K of Fig.65 of the mechanism for the release of the vibrator means as well as the release mechanism for the reventilation by means of spring-actuated mandril or pin.

The Figure 71 is a simplified cross-sectional view I - M through Fig.65, showing the dosage pump arrangement. It shows, below, a cross section for illustrating the embedding of the hose or tube in the supporting discs of the roller axes in the direction of the arrows.

The Figure 72 is a schematic view of a rolled-up projection along the plan view O - P of Fig.65 of the vibrator.

The Figure 72 is an enlarged view on the scale 2 : 1 of a cross-sectional view through an alternative embodiment of the pump arrangement with

respect to Fig.65 with four roller pairs jamming respectively one of both tubes or hoses between one another.

The Figure 74 is a schematically rolled-up plan view in the direction of the arrows of Fig.73 at a normal or natural scale, wherein the guidance of the hoses is readily seen.

The Figure 75 is a highly schematical longitudinal section showing an alternative embodiment of the release mechanism for the vibrator means, and the upper part of a vacuum reservoir cuplet. The Figure 76 is a highly schematized representation of the four functions stage A to D of a mechanism for the reventilation by means of sliding valves.

The Figure 77 is a longitudinal section through the injector with a dosage device integrated within the hose in the manner of a piston-cylinder pump, a screw cover with a mechanism for automatically scaling down the drug or preparation supply container, and a suction cup rim with elastic lips, which is associated with the injector, as well as a release device for the bottom cylinder of a vacuum reservoir cuplet, which device assumes the holding or retention function of support means for the cuplet proper to be removed prior to the use of the injector.

The Figure 78 is a view in cross section A - B of Fig.77 of the locking mechanism.

The Figure 79 shows a rolled-up projection of Fig.78 in a schematical longitudinal section.

The Figure 80 is a schematic view representing the two functional stages A, B in Fig.77 of a mechanism for the reventilations by means of a sliding valve.

The Figure 81 is a view in longitudinal section of an injector with a solenoid-operated tube-integrated pump similar to the one shown in Fig.77, wherein a roll or reel of sheet foil as-

5 sures a uniform feed or advance of the drug or
preparation as carrier of chemicals for the
gradual generation of pressure gas in connec-
tion with a pressure control valve, and wherein
a device is provided for thermally generating the
negative pressure or vacuum for the suction cup
within three separately activatable storage or re-
servoir chambers.

10 The Figure 82 is a cross section taken in the di-
rection C - D through the vacuum reservoir cham-
bers and the suction cup of Fig.81.

The Figure 83 is a partial schematic rolled-up
projection of the mechanism for opening the flap
valves to the vacuum chambers.

15 To the left of said Fig.83 is a schematic rolled
up view of the course of the grooves for the cam
of the feed cylinder of Fig.81 so as to explain
the sectoral rotation thereof after lowering the
drug or preparation container towards the pump
housing.

20 There below(III) the release function is explained
in a cross-sectional view A - B to Fig.82.

The Figure 84 is an illustration of a modified em-
bodiment of a vacuum reservoir cuplet similar to
25 the one shown in Fig.77.

On the left half of said Figure the transverse
slot can be seen wherein the bottom cover is
locked;

30 in the right half of said Figure is seen, after
removal of the latter, the stop of the annular
piston through a locking lamella of the injector.

The Figure 85 shows a schematic cross-sectional
view through the suction cup collar of an injec-
tor, wherein a clover-like lobed cross section
35 can be seen with the release pins being located
outside of the suction cup.

Figure 86 is a longitudinal section showing a vacuum reservoir cuplet of the single chamber type with a removable covering of the suction cup in conjunction with an illustration of a locking mechanism for the draw-pull or plug-in cylinder supporting the bottom ring and being associated with the injector, while also showing a device for controlling the seat of the can- nula with regard to the contact of the blood vessels.

The Figure 87 is a schematic view of the various steps of the method for producing a vacuum reservoir cuplet in keeping with Fig.85.

The Figure 88 is a view of a vacuum reservoir cuplet of the type used in Fig.65 within the conductor cylinder in the stage wherein, in longitudinal section, the skin has been raised by way of an equalization of air pressure.

The Figure 89 is a schematic longitudinal projection at a scale of 3 : 1 of both of the sectional ridges facing one another for deflecting the valve rod in the injector of Fig.77.

The Figure 90 is a schematic longitudinal section of an holding angle as connection means between an electromagnetic buzzer and a ring around of a dose pump as mechanism to mix the drug components.

The Figure 91 is a longitudinal section of a medicine-containing folded bellows, which is exhausted through a hose with therein integrated pump without a separated pump housing.

The Figure 92 is a simplified electronic principle-set-up for the injection by means of a device as represented in Fig.81.

The Figure 93 is a kind of electronic flow chart for the computer controlled indication of the consumption of the medicine stopck, the alert signal just before imminent supply exhaustion, and for locking the operation or functions of the injector so as not to dispense when there is an insufficient residual amount of medicine as in Figures 81 and 82.

5 The Figure 94 shows in the longitudinal section a lock-up device of the medicine supply until that supply is exhausted.

10 The Figure 95 shows in the longitudinal section a variant of the hydraulic dosage.

15 The Figure 96 brings below a plan view and above a loingitudinal section along to the section line A - B of a dose mechanism, wich is stroked by pressure of a solenoid.

20 The Figure 97 brings in the longitudinal section a worm-formed dose mechanism similar to that one of Fig.96.

25 The Figure 98 shows in the longitudinal section a dose mechanism.

30 The Figure 99 shows in the cross section a hose throttle which is connected to a electronic flow-through measurement.

35 The Figure 100 shows in the longitudinal section a dose-change by means of a change gear, what means a dose mechanism for two drugs by means of an single motor.

 The Figure 101 -also shown in the longitudinal section- performs the same task by means of different attractive velocities of a piezo-pressure conductor.

 The Figure 102 shows in the longitudinal section the motion of the cannula magazine towardly and backwardly the skin by means of suction in a two

functional stages.

The Figure 103 shows in the longitudinal section two functional stages of an injection by means of the raising up of the skin by plaster-traction.

5 The Figure 104 shows the polarized-photometric control of metabolism through the knob of the skin which is raised up into a suction cup.

The Figure 105 shows the basic experiment relating to the influence of the conductivity of a membrane with sepharose-concanavallin A by glucose.

10 Figure 106 shows in a schematical longitudinal section a photometric measuring arrangement about the suction cup using a light sources and sensors bearing ledges; at the left hand side the skin is raising, at the right it's already raised. A ray absorption graph is shown; the measuring events simultaneously.

15 Figure 107 shows a device similar to said of Fig.106 with two measuring rays wherein a subsequent measurements are used.

20 Figure 108 shows in a schematical cross-section a measuring arrangement similar to said of Fig.107; the ferretting out of blood vessels is demonstrated.

25 Figure 109 is similar to Fig.108; additionally a thermography and a reflex photometry is shown. Figure 110 is a partial schematical cross-section through a skin knob inside of a suction cup with a diaphanic measuring arrangement.

30 Figure 111 is a principal set up of the use of a measuring arrangement as in Fig.110 combined with a such as in Fig.107.

35 Figure 112 is a longitudinal section of a mechanical suction injection as a type simmlar to Fig.70 but with essential new embodiments.

Figure 113 is a schematical cross section along line A - B of the Figure 112.

Figure 114 is a other schematical cross-section along line B - C of Fig.112.

Figure 115 shows at a scale 1 : 5 an injector consisting of two parts, namely a grip and the
5 suction cup connected by a spring to permit angle shifting movements during the injection. A schematical longitudinal section is shown. Figure 116 is a such respective to Fig.115, but the same task is solved with a kind of spring
10 resilient over beaker.

Figure 117 shows a cannula with a hoslet inside of its shaft, which is bent over; during the injection this hoslet can unfold and prolongs the cannula shaft. This is done at a scale 5 : 1 and
15 a longitudinal section.

Figure 118 shows a cannula similar to them of Fig.115, wherein the hoslet is turned the inside out.

Figure 119 is a third kind of cannula with very elastic hoslet, which can be stretched.
20

Figure 120 shows in a longitudinal section a type of dosage hydraulic using a step syringe similar to said of Fig.95; but an apply of auxiliary fluid from outside is avoided thereby.

Figure 121 shows a variation of the device of Fig. 118.
25

Figure 122 is a type of vaccum reservoir couplet with a release mechanism operated by a tripping mechanism of the suction injector; a schematical
30 longitudinal section is choiced.

Detailed Description of the Drawings(Examples):

Figure 1 is a plan view of a filled hypodermic or injection syringe(233) with a clamp(227) mounted thereon and from which contacting terminals(228) issue which are placed on the sensor coat of the cannula(326).

5
Over that a cross section having the scale 2:1 shows the seat of the contact terminals about the shaft of the cannula. From these contact terminals the conducting line(234) leads to the housing comprising the measurement device (288) as well as the reader(289) with its printer. The cable(240) connects the measuring device to the contacting plaster(228) for the skin, which plaster functions as comparison electrode. After the cannula has been introduced under the skin and after the lapse of a certain period of time, the measured value can be read.

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Figure 2 is a view of a device similar to the one shown in Fig.1. However, the injection cannula(326) with the sensor coat is deposited here within the reservoir cuplet preserving the vacuum (as has already been disclosed in the Canadian Patent No 1 189 412 of June 25th 1985 in Fig.3 and 4 and in the laid-out document O 103 664 of the European patent application. The conductors(234), encased when manufactured, in contact with the cannula coat lead to the socket(235) in the cover. The valve pin(229) is located within its guide tube(230) placed in the center of the reservoir cuplet(In this case when of elliptical form in one of its centers). It is provided as inventive improvement with a leaf spring(231) supported on the suction cup rim. This spring is shaped in a convex arc to-

wards the skin and attached in the center by a valve pin, the tip-shaped end of which is spaced from the stretchable cover sheeting or foil(232). The cannula is located adjacent to the valve, but not in projection to the leaf spring. The contacting plaster has been replaced here by the adhesive electrode(239) on the suction cup rim, which electrode has its proper encased lead(236) to the jack. Before carrying out the injection, the plug-in nipples of the lead(236) and of the cable(240) towards the measuring instrument(388) are inserted into the jacks(235). The injection syringe(233), filled up in an usual manner, is stuck up onto the cannula attachment piece, the protective foil or sheeting ring(237) is withdrawn from the suction cup rim prior to use. If the reservoir cuplet subsequently is pressed against the skin to prepare the injection, so the valve pin is raised. The leaf spring takes on tension and, finally, turns upwards whereby its ends leave the suction cup rim. Thereby the valve pin is shot explosion-like upwardly and pierces with its tip the covering foil (after it was stretched out) causing the equalization of air pressure and the raising of the skin. (The stretching of the cover sheeting or foil hinders that the opening of the valve takes place before the suction cup rim is firmly closed by the skin). The protective foil or sheeting ring(237) is withdrawn from the suction cup rim prior to use. The measuring instrument(288) may also preferably be supported on a resilient jointed-band(241) and the adhesive electrode may then be replaced by contact pads underneath the measuring instrument. The dosing device comprises, similar to those shown in Figures 71 or 82 a pump to be clock-actuated by exerting pressure on the grip

strip(180). That pump is fitted on the hose(44) and is fixed by the container cylinder(19) with slotted walls by means of the screwing(578). The drug containing folded bellows(731) is fastened on the container cylinder by means of an attachment ring(579). Said attachment ring serves to the pressure spring as a counterseat to remove the rod(110) and to effect thereby the drug ejection. After the reservoir cuplet sticks to the skin, the result of the measurement will soon appear and a corrected dosis, as determined by the computer, can then be dispensed in a clock-actuated manner.

The Figure 3 illustrates the combination of the sensor and dosage compensation means (equivalent to the computer) comprising a customary insulin infusion pump(245). Incorporated in and with the housing of the infusion pump is the measuring instrument(288) as comprised of the dosis compensation device(288) consisting also of the reader(289) and the computer(246). The conducting wires(234) connected to the components of the sensor cannula are insulated and guided, over a certain distance, within the wall of the feed hose(236). Further down they have their own insulation and are connected to the jacks(235) in the housing of the control unit(175).

The Figure 4 shows in the longitudinal section and on the right the cross-sectional detail of a cannula attachment piece in connection with a hose coupling piece. The cannula attachment piece(47) comes near to contact with the plug-cone(570) of the feed hose(236). The holding clamp with the sliding contact(254) inside is not yet engaged into the groove(581) towards

the cannula wherefrom contact is produced through the little wire(577) with the cannula shaft. From the sleeding contact the cable(240) leads, over a certain distance, within the wall of the feed hose insolated to the measuring instrument. From the sensor coat another little wire leads through the cannula shaft to the inner contact(253) which is within the boring of the cannula attachment piece. There this touches with the conductable surface of the plug-in cone and on such a way over the conductive wire(234) with the measuring instrument.

The arangment of Fig.3 comprises most suitably also a measured-value memory or storage so as to allow displying on a screen or reproductive device(255) all numerical data -possible expressed as curves- expressing the response of the measured-values at low dead load for the patient, which data are thus readily available to the physician.

The Figure 5 represents a principle set up of such a device. The hardware for this comprises a processor controlled system for storing measured quantities, to evalute them while paying due attention to eigenindicators and master parameters of the system (without instruction from without). The essential part of the system is the CPU. As store for the firmware of the system of operation useis made of EPROM/ROM, for filing non-volatile yet variable data (e.g. master or routine parameters) use is made of RAM as intermediate quantity storage.

The Figure 7 shows the principle circuitry which is capable in storing measured quantities

or values at regular temporal intervals (e.g. of 15 minutes), which quantities are read out by a processor system equipped with the appropriate interface.

5 A. Recording the measured quantities: In the last reading of the measured quantities all stores and address counters will be reset to "zero". The first timer pulse write the actual measured quantity into the storage location or cell of the address(000) and raises the address counter
10 for the clocked input by one. The second timer puls repeats this procedure with the next address(001) and so forth.

15 B. Reading the measured quantities: Via the interface the state of the enabling circuit is modified with the consequence that the AD transducer is separated from the data bus and the timer is set at rest. Now, after initiating "Reset" via the data bus the storage contents can be read by count-up of the address counter. The data word
20 or item(00) is used as end of recorded information. Subsequent to the read operation the initial state as described under A must then be re-stituted.

25 Figure 8 shows in a natural size exept for a shortening of about 40 millimeter the housing cylinder with the drain hose and the folded bellows and the taking up socket for the inserting cylinder in the longitudinal section. The device
30 is principaly suitable for the operation by means of a permanent suction source. As such may serve water stream pumps or vacuum cleaners. The housing cylinder(701) with the basic ring(702) carries the tube socket(703) with the bayonet

guiding groove(704) which serves to fasten the
inserting cylinder(Fig.9). The folded bellows(705)
tightly screwed with the basic ring(702) by the
holding ring(706) and this is screwed by the faste-
5 ning ring(707) with the piston(708) whereby its
guiding shell(709) prevents from squaring. Inside
of the central boring of the piston(708) deemed
in a loose gliding seat the sliding tube(710)
which is tightened to the tent-like membrane(711)
10 by screwing. The shifting tube(710) continues
above into the drain hose(713) which lies, in spi-
rals owing to the tension made in advance, below of
the lid cap(714) and leaves this through the faste-
ning sleeve(715) toward a water stream pump or to-
15 ward another suction source. The carrier ring(716)
for the permanent magnetic pegs(718) which are
magnetically closed together above by the iron
ring(718) is fastened to the piston(708) by the
screw-pegs(719). Through its central boring the
20 carrier ring(716) lets pass the shifting tube
the end of which is slotted to let pass air easier.
Through a peripher boring passes the trigger
tube(721) likewise in a sliding seat for the
sealing valve stem which slides as an octagon
25 square to facilitate air passage in the valve
boring with lid weakly biased by a pressure
spring. The channel(722) leads out of the valve
boring sideways toward a slot of the guiding
shell(709) which is open upwards to let in the
30 outern air throught the cap bore(722).

Figure 9 shows in the longitudinal section the
inserting cylinder(724) with a slope for the
sealing(725) and the both bayonet pegs(726)
35 and the opening of the suction cup towards
below. Inside of the inserting shell or cylin-

der with an upwards club-like thickness the
shifting shell (26) is arranged which is pressed
by the weak pressure spring (729) against the
iron plate (730) stuck up to the inserting
5 shell and which thereby holds the syringe (233)
on his flange upwards. The covering lid (732)
for the suction cup which is often dispensable
subsists by rubber elastic material whilst the
other parts - except for the shifting tube (710)
10 and the trigger tube (721) which may be also metal-
lic- are produced suitably by acetate plastic or
Delrin or similar material. Slide contact (254)
into the inserting cylinder is adjusted towards
the cannula shaft, an contact spring (576) is ad-
15 justed towards the canula attachment piece of a
proper sensor cannula connected to contacts. (Inste-
stead of the conductive coat of the plug cone (570)
as in Fig.4) the surface of the cannula attach-
ment piece is conductively therefore) The wire
20 (234) and the cable (240) joint the injector with
the measuring instrument.
To prepare the injection the syringe will be filled
from a flask in an usual manner than furnished with
a sensor cannula and introduced into the opening of
25 the inserting cylinder in such a manner that the
flange of the syringe cylinder passes through
the oval boring (see Fig.10) of the iron plate.
Answering the purpose- in particular if the inser-
ting cylinder for syringe will be introduced into
30 the tube socket (703) the syringe stem pointing
downwards- the syringe is turned over perhaps 45°
by its stem to avoid that it falls out. During the
fastening inside of the tube socket (703) by turning
of the inserting cylinder until the bayonet pegs
35 are blocked the sealing (725) is pressed against
the bottom or basic ring (702) and works therefore
between the housing cylinder and the insertion cy-
der. Suitable an eventual store is effected in-

side of a clean linen. The suction injector at best is connected constandy with a permanent suction source for example with a water stream pump as described in Figure 12.

5 For this purpose a conically amplified end of a water hose is shortened as far as it can be shoved up tightly to this part of water-tap which is at hand in the household with the outlet opening who it is able to be squeezed firmly by a band clamp(738) .
10 which bears the holding arm(739). This again shows the axis(740) toward the jaws which may be fixed by means of a thumb screw. Into this jaws the tube(743) of the water stream pump may be shoved and squeezed fixed with the thumb screw(742). Because the mouth
15 of this stream pump may be straightened into any direction and the water stream before is guided through an eddy mechanism the tap is easy to use, whereby at a time air is sucked on over the socket (745) with the drain hose(713). For the purpose to
20 inject the patient has to take the injector out from the linen which clings to a hook or lies on a place of deposit and has to straighten the suction cup toward any body partie(so far as it proves to be not unsuitable for the injection by its sensivity
25 and its nature as skull partie or anus or soles or palm) after he has opened the tap and thereby has activated the stream pump according to the arrangement of the Fig.12. At first than the skin is elevated into the suction cup by suction and fastened
30 there, then the membrane(711) with the easily working sliding tube(710) is sunk and finally the piston(708) with the folded bellows(705) and therby at first the injection syringe(233) is pressed against the pressure spring(229). After the shifting shelf(728) is stopped on the botom of the insertion cylinder(724) and the cannula is entered
35 into the highly drawn skin the syringe stem is

sunk until this stop and the syringe is emptied. During the last millimeters of the distance covered by the carrier ring(708) which is taken along with the piston(708) its magnetic pegs are attracted by the iron plate(730) which facilitates the triggering tube(721) to be elevated and which thereby facilitates the reventilation valve to be opened, so that the outer air may enter through the canal(722) which causes the syringe to be elevated by the pressure spring(729) because the vacuum below the membrane (711) is suspended, while the skin is withdrawn out from the suction cup and while the folded bellows with the piston(708) further remains held fast by magnetic power. The patient is able to ascertain while the housing cylinder(701) is transparent or by the longitudinal slot(733) if needed by feeling with the finger before the device is deposited. If the screwing of the inserting cylinder(724) is loosened in the bayonet grooves while the pegs(720) are turned back, so the iron plate(730) removes from the magnetic pegs and the folded bellows expands again by its own elasticity and the return valve is closed by its pressure spring. It may be yet supplemented the pressing peg (574) which is attached on the shifting shell(728) and which, while said sinks, pushes against the contact spring(574) and approaches them to the cannula shaft. On such a manner is avoided the pollution of that area of the cannula which later enters into the skin.

In Figure 11 a part of the device is demonstrated similar to this of the Figures 8 to 10 which shows a variation of the reventilation valve and the automatically operating of them. The housing cylinder (701) is separated in a upper and a lower part by a blank(746) with obliquity of wall which are held together by the fitting bush(747). The piston(708)

is connected with the folded bellows(705) and contains in its central boring the sliding tube(710) which upwardly shows a notch and the inner lumen of which towards above continues in a little folded bellows(749). This again continues in the drain hose (713) which is sealed by the fastening bush(715) in covering lid(749). In a transversal boring of the piston(708) two pegs with rounded tops are shiftable mounted thouse elastic sealing caps(751) are able to uncover the borders insids of the borings(752) towards the entrance into the smaller borings(753). Out of the smaller borings(753) channels(722) for the reventilations leads upwards. The lower end of the sliding tube(710) is amplified and lengthened to a pot(754). If the folded bellows(705) is detented the little folded bellows(799) extends, the pegs lie over the obliquity of wall of the blank(746) inside of the depth of the notch(748) shifted insidwards during the raising and the sealing caps(751) tightly are pressed onto the little borings. By the working of suction the piston(708) can be sunk after the suction cup is closed by the skin; after the pot(754) has touched the cover lid(30) of the inserting cylinder it is lifted and also the sliding tube(710), whereby the obliquity of the notch(748) the pegs shoves outwards which happens even during the stadium at which the piston sinks during their ends are able to make away for the blank(746) of the housing cylinder, by which the piston is avoided to be elevated so long as the sliding tube(710) is able to make away for below after the inserting cylinder is removed, promoted by the elasticity of the little folded bellows(799). The moment of the turning away and outwards of the pegs(750) during the piston has its lowest level, is also that in which the elasticity is overtaxed, so that its borders are teared off from its seat before the en-

trance of the little borings(753). By this means the air-stream is released in the rear of the piston onto the interior of the folded bellows (705) for the reventilation.

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Figure 13 is a longitudinal section of an injector device, wherein the vacuum for the suction cup(51) is generated by means of a CO₂ pressure gas capsule via the gas jet pump(257), which vacuum is preserved there by way of the pressure control or relief valve. Relief of the compressed gas takes place via mandrel(258) with groove, which mandrel is fixedly and tightly screwed to the valve block (258). Two coupling valve follow the valve block downward from the bridge(260), thereafter a control shaft with cannula magazine(262), a front and rear dosing spindle, respectively, with threadings for the associated dosing nuts(164) -as can be seen in the Fig.14 in the cross sectional view-, slide valve(265) and slidable pump housing(111) for the dosage piston stationarily held on a bar. All component parts mentioned as far, and others, belong to the device equipment to be reused, while the housing of the plug-in unit to be thrown away contains the CO₂ pressure gas capsule(256) above the - sieve-like perforated- accomodating tube(269) for the swelling pin, the elastic bag(271) with the auciliary fluid, and the step syringe cylinder(272) made from silicone coated glas. This latter terminates on the top in the valve tube(273), whereabove the shiftable collar(274) is mounted. The separating piston(275) between drug and auxiliary fluid is provided with an envelope of wax (276) and terminates in the hook-shaped discharge tube(277) branching off laterally and reaching from below into a bore of the cannula magazine (316). The plug-in unit and the device or equip-

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ment part are bolted one to another by means of an attachment spindle(279). For tightening the square check or binding nut(280) the resilient ring(281) is used, which can be acted upon by the pipe socket (282) with its hinge or joint(322) by means of rotating the arm(342) with its joint or hinge(322) for the suction cup cover(342). The angle or wall bracket(283) is used for locking the dosing pump. Said bracket comprises power transmission between the locking ledge(283) in the control shaft and the sliding cylinder(285) being slidable over the cylinder of the pump housing against the compression springs(284), which sliding cylinder(285) is guided in the external cylinder(286). About a longitudinal axis the wedge(287) for the dosis change is pivoted in notches of the locking ledge, and also the holding slot for the tensioning loop(288). The cannula tube(289) being, behind the lip seal (290), extended or enlarged in the form of a pipe is made to contact the end of the used cannula by means of the holding arms or brackets when closing the cover. In the upper part one can see the compression spring(291) for the cover sliding head (292) as well as the accomodating sleeve(293) for the bag(430) filled with auxiliary fluid. From the gas channel the cross channel(294) is seen behind the sluice valve -which is described in greater detail in Fig.19. This channel(294), behind the locking ball of the nonreturn valve(295), is connected via the channel(296) through the cannula (297) within a plug membrane in the housing(229) to the gas reservoir(429) of the plug-in unit. The channel(299) is connected via the nonreturn valve(298), extending via a jet or nozzle into the hose connection(431) up to the end of the cannula magazine and arranged parallel to the non-return valve(295), to the gas jet pump.

Figure 14 shows a partial cross section through an injector of the Fig.13 along to the section plane A - B there. The elliptical suction cup(51) with the central pin(433) and the cannula magazine(316) in the interior, likewise the step syringe cylinder(272),
5 the outside cylinder of the dosing pump for the auxiliary fluid, the dosing spindles(263) with dosing nuts(264) and the locking ledge(283).

10 Figure 15 shows in the cross section along line A - B of the Fig.19 the sliding head(292) of the cover with its pressure spring(291) and the bolt or pin(449) of the flap hinge. Moreover, the U-bent of the transversally extending cannula magazine(316) has been rendered visible.
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Figure 16 shows in the longitudinal section a fluid coupling device whereby the plug-in is approaching to the cover bridge. To the fluid outlet opening(442) on the accomodating cylinder ventilated in the top, closed by the resilient sliding sleeve(444), corresponds to the fluid inlet(262) in the valve tube(273) of the step syringe cylinder
20 (272), which aperture is closed by the sliding collar(274) and will first be displaced when the shoulder of the accomodating cylinder will approach the aperture or opening, whereby the cover of the valve tube will, additionally, displace
25 the sliding sleeve(444).
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Figure 17 shows in a cross-sectional view the gas jet pump(257) with the gas adflux channel(446) and stub leading towards the suction cup, and
35 the the suction or vacuum retaining nonreturn valve(448).

Figure 18 is a drawing on a scale 2 : 1 showing on the right side in longitudinal section the cannula exchange mechanism. The snap-in ball (432) is urged by the central pin(433) in its bore(434) within the accomodating cone(435) for the housing(575) of the plug-in unit through a lateral slot in the cannula magazine into the central notch(436) of the cannula body. The latter can be descended via gas pressure, having for a short time accumulated behind the cannula magazine, first at that instant when the central pin has been lifted up completely. In this connection, the lateral flattened portion(437) thereof allows the snap-in ball to recede from the cannula. The cannula descends up to the resilient locking pawl(438). If the central pin descends once more, it will again displace the snap-in ball because it can evade into the upper notch of the lower cannula and in the lower notch of the upper cannula. If the contactor pin(356) in the cover actuates the pawl, the cannula may be taken over by the lip seal into the accumulator tube of the cannula. Since a slight lift of the central pin permits, when closing cover, the snap-in ball to pass a gap in the central pin, the subsequent cannula steps further downward. The small channel(439) in the body of the cannula registers in the position thereof on the pawl with the drug output opening(440) from the step syringe. The illustration to the left in the cross sectional view shows the oval configuration of the cannula and cannula magazine as well as the lip seal above the snap mechanism of the central pin, as described.

Figure 19 is a surface longitudinal section of showing the flap hinges with the flaps of the

front(shown in dashed lines). In the center of the flap a rectangular slot(452) has been left free for the clearance of the dosing nut.

5 In a plane far to the rear one can see to the left the "sluice" valve. The gas channel(294) from the CO₂ pressure gas capsule connects to the compressed air chamber(455) closed by the large valve disk or head(456). In its central bore a small valve cone sits on the narrowly terminating pin in

10 front of the abutment plate(457). The pin is ground in the slide valve cylinder(458), extends therein, and is provided with an annular (tee-) slot. In the slide valve cylinder the gas is laterally fed from the high-pressure chamber and is,

15 then, subsequent to the flap pin(461) having descended under the influence of the wedge slant of the slide(461), conveyed further to the cross channel via said annular slot or groove. Prior thereto, after ejecting the small valve cone, gas

20 banked up or accumulated in the pressure chamber with the slide valve being still closed, which permitted ejection of the large valve disk by means of the abutment or pressure plate.

25 To the right under II in the vertical section along line A - B of the longitudinal section one can see closed flaps(445) comprising the flap hinges(450), and the contacting support arms(463), the left whereof supporting the bolt or pin(449). To the left the opened flap is illustrated in dashed lines.

30 Under III the left flap can be seen in plan view on the level of the slot(452) with the dosing nut.

35 Therebelow under IV a cross section is shown within the cover bridge. One can clearly see the influence of the cover sliding head(292), above its wedge slant(464) by means of its pin or bolt (449).

Figure 20 is a vertical section across the control shaft, wherein both of the dosing spindles (263) with their dosing nuts(264), the attachment
5 tng or hinge(465) for the axis(466) of the wedge
 (287) for changing the dosing, the burling- or
 nap-type spring in its connecting link guide(72).
Therebelow the resilient pin is shown for manual-
ly switching over between the adjusted dosages.
10 the tripping or release means(469) is provided
 with a profile nose(470) for engaging the snap-in
 notch of the locking ledge against which it is
 pressed by means of the leaf spring(471), while
 being rotatable about its axis(472). To the right
 the restoring spring(472) of the pins(468) sup-
15 porting the snap-type springs are illustrated,
 being guarded against rotation by the guide pin
 (471) sliding in said slot. Ther carrier plate,
 on the right control shaft above the suction cup,
 transmits the movement of the central pin(433) to
20 the semi-groove(475) adjacent the outer cylinder
 and subdivided into two legs and from there to
 the cover slides. Therebelow the link(476) ad-
 justable in hight relative to the central pin is
 shown for mounting the dosing spindles(263) safe-
25 guarded against rotation.
The partial cross section below Fig.20 gives an
even clearer illustration of the position of the
component parts.

30 Figure 21 is a view on the scale 2: 1 showing the
 release means for the fluid injection in greater
 detail. The profile nose of stud(470) on a pro-
 jection of the locking ledge(283) is shown in
 cross section in the lower part thereof.

35 In longitudinal section the overrunning spring
 (477) is shown in the upper part thereof, which
 spring slidngly abuts the fork-typ aperture

(as shown to the right in the direction of arrow A). The release or tripping slide(484) on the end of the central pin causes, when lifting its upper wedge slants against the overrunning spring, the turning off motion or deflection of the trip means(485). It engages with its fork the notch(485) due to the influence of a leaf spring(471). Once the central pin returns, subsequent to injection, while being directed towards the skin, the upper slant or obliquity of the notch(485) slides the overrunning spring backward, and the tripping slide is enable, within the fork opening(483), to overtake the tripping means.

Figure 22 is a transversal section through the control shaft -forming the intermediate space between the plug-in unit and the dosing pump- above the tripping means on a scale 2 : 1, showing the mechanism for the dosing stage selection. it is readily seen that the pin(468) for the altering the dosing can be lifted with its bearing bush on the locking ledge(283), while the counter pin(499) remains stationary with its powerful compression spring. On the cross pin(501) it can be descended in the guideway of the wall slot(500). The pin(468) is advanced downward under the effect of its spring, and the nap-type spring effects, by way of its progress within the connecting link guide(72) of the contactor or tripping calinder(which is shown to the left), an axial pivot of the tripping cylinder and, hence, also of the wedge attached thereto and bent thereon, for the dosing operation. Thus, it is possible to carry out the change as to the selection of the dosing stages without triggering the dosing operation.

Ther cross sectional view therebelow shows the angular displacement between tripping cylinder

and the wedge(287) as well as its position above the dosing nut(254). The wedge position in dashed lines illustrates its position subsequent to switch-over.

5 Figure 23 is a view of the control arms issuing from the semi-groove, and the cover slides thereof with the counter and locking device in a partial longitudinal section as well as in the central view in cross section and, once more, there-
10 below in a plan view. To the right there is shown, additionally, a transversal section.
The end roller(486) of the control arm of the central pin acts, when being lifted, on the wedge
15 slant of the slide, while moving ist to the left. The snap-in pin(488) thereof takes the valve opening slide along with it by frictional-type locking, which slide descends the cap pin(461)
20 by means of its wedge slant and it opens in this way the valve downstream of the CO₂ capsule. The profile guide(490) of the cover plate(492) by deflecting the guide pin(491) for the snap-in bolt to be displaced against its spring action. Both
25 of the slides(487,489) are unblocked in this way. As can be seen quite distinctly on the right side of the transversal section, the edger bar(493) issuing from the central pin is provided with nap-
type tipping means(494) which comes to rest, when
30 lifted along a stroke length, in a recess of the valve opening slide, thereby preventing its return movement under the influence of the compression spring(495). In the peak position of the
central pin its nape-type trip leaves that recess
35 in the valve opening slide so that the latter can return into its initial position by closing the valve. The slide(487) is only then in a position to return under the effect of the compression

spring(496) in its initial position, when its wedge slant has, subsequent to the descent of the central pin, has left the end roller(486). This return movement is effected by the movement of the cover sliding head(292) first under the effect of the compression spring(291) -which sliding head is shown in Fig.13- via the wedge slants acting on the end roller(498). The cover sliding head, in its turn, is first activated when, by way of lifting a dosing spindle(263) on account of its interconnection, via the connecting link(476) the cross or transverse pin has been raised via the snap-in stage in the oblique slot(267)(Fig.13,19). Together with lifting the connecting link the rod of the venting valve(324) attached thereto is also raised against the action of their spring means, and the suction cup is reverted.

Figure 24 is in its upper part a longitudinal and in its lower part a cross section showing the counting mechanism for the number of dosing to be carried out. The stem(502) which, in extension of the central pin, sets out from the semi-groove, actuates the transport means of said counter by lifting the pinion(504) within the switch jack (503). The four switch cams(505) are guided within the four axial guiding grooves(406). Lifting and lowering effect in same shares a rotation of the narrowtoothed wheel(507), which rotation is transmitted by it to a flat and broad toothed wheel which operates as counting wheel equipped with a number scale. The counting wheel is mounted on a pin(512) having fine threading thereon. This pin is gradually raised in its threaded bush until the cam(509) hits (after one cannula magazine has been emptied) against the the locking pin(511) on the blocking slide(510)

activation the blocking (after the cannula magazine is renewed) may be released. When the insulin supply is exhausted, the cam(509) pushes against the locking edge(513) on the locking slide. The blocking is suspended by screwing backwards the great toothed wheel(508) by means of a socket wrench. The number of rotations events according a table which is fastened at the device, whereby the number of utilizations is classed with the height of the both adjustable insulin doses.

Figure 25 shows in the longitudinal section on the scale of 5 : 1 the mechanism of the counting device transport with pinion(504), gear cam(505) at gear bush(506) and the little toothed wheel(507).

Figure 26 reproduces a rolling up of the inside of the gear bush(506), whereby the arrows mark the path of a gear cam(505).

Figure 27 shows in the longitudinal section in the scale 1 : 1 a cannula magazine(262). Schematically with dashed lines the cannula bank-up tube(289) is transformed to a such manner as to lead back used cannulas into the magazine. A cross section of the magazine, inside the bent of the upper magazine on the scale of 5 : 1 with a flattening, continues in bent toward the right and it shows in the longitudinal section the position of stack cannulas with curved back(515), which cannula is also shown in the cross section and in the vertical section. The push-on spring(516) effects the pushing upon the drug outlet opening through a thinning of the magazine wall.

Figure 28 is a longitudinal section on the scale of 5 : 1, showing a dosing pump wherein the flow of the drug occurs from the bottom to the top. Such a pump can be used with the equipment of Fig.13, but also with those of Fig.78 or 82. It consists of an

outside piston(518) which is sealed with respect
to the cylinder(519) by means of seal(517); fur-
thermore, of an inside piston(520) slidable in
the inside bore of the outside piston, and it can
5 be closed against the conic slant or obliquity
(523) by means of the seal or packing ring(521)
in raising the inside piston or the piston bar
(524). When the piston bar descends for opening
the valve subsequent to the termination of the
10 dosing stroke (upward), the inside piston en-
counters resistance on the stop bush or sleeve
screwed in the outside piston. Both pistons can
thus be descended together during fluid flow
(through). Dosing takes place by raising the pi-
15 ston bar after closing the valve on the seal or
packing ring(517).

The view in cross section to the right of the
longitudinal section shows fluid passageway(525,
526) quite clearly.

20 For making an injector according to Figures
13 to 27 operative a selective sheeting or
foil covering a plug-in unit -which is renewed as
entity- is withdrawn. Water -preferably from a
prepared syringe- is filled in past the CO₂ gas
25 pressure capsule. The plug-in or slide-in unit
is placed under the cover bridge(260),
the fixing spindle is placed in the wall furrow
or channel(460) of the plug-in unit(cf. Fig.14),
and this is screwed with the installation part
30 by using the holding arm(341) as lever arm. There-
by, the cannula(297) pierces through the
belonging seal toward the gas storage space(480)
and the air-free fluid coupling to the bag(271)
is effected. After the predetermined time, the
35 swelling pin(270) has taken so much water as to
have raised the CO₂ capsule against the mandrel
(358), whereby the latter has pierced the soft

iron seal. Subsequently, a cannula magazine is inserted from above. As far as the seat of the tablet with the drug outlet opening(440) is complete inside the wall of the cannula magazine (c.f.Fig.14) the central pin(433) must be elevated shortly as to let past the ratched ball (527). At the dosing screws not are adjusted the dosage steps -p.e. for morning and evening-by adjusting on the height upon the dosing spindles compared with a scale. The pressure spring (284) is stretched by pulling down of the traction-loop(288) in which the fingers are stuck in. Thereby, the piston(168) is descended and is filled through the afflux lead or channel(528) and the sliding valve(Fig.13) with auxiliary fluid from the bag(272). If the the flaps(445) are pressed together, the cover slide is shifted towards the left hand side against its pressure spring. Thereby, the piston of the slidingvalve (265) is sunk and the derivation channel or drain(529) is given free towards the step syringe cylinder. Through the plug-in bushs(235), wherefrom the leads or wires extend towards the sliding contacts(584, Fig.27) for the cannula contact, the connection towards the measuring device follows. The counting wheel for the locking of functions, after the cannula or the insulin supply are exhausted, must be rotated back, otherwise the motion of the central pin within the gear busch(503) being stopped(Fig.24). During the swiveling of the suction cup cover (342) the last cannula, which closes up the magazine, -within the beginning of the magazine this is a shaft-less cannula body- will be removed. If the suction cup is pressed against the skin, the central pin, projecting a bit, is raised yet before the suction cup rim has touched the skin, and the gas stream towards the gas jet

pump(257) is given free. The ratched ball(527) receeds into the flattening of the central pin (Fig.18). Therewith, the cannula steps lower and thus is done under the influence of damming up gas between the nonreturn valve(295) and the sealing body(585) at the end of the cannula magazine; subsequently said cannula steps towards the skin, whereby the hollow space connection between cannula shaft and drug outlet opening, prior interrupted, is restituted. During the further raising of the central pin, which may success without resistance by the elevation of the skin due the particularity of the shaping of wedge profile(Fig.24) on the slide(487), this activates the trigger or release(419, Fig.20.21)? Therewith the sliding cylinder(285) is moved together with the piston(268) on its piston rod (524) by the pressure spring(284) so far as the wedge(287) permits as to its stop on the dosing nut(264). The auxiliary fluid is transfered through the sliding valve behind the separation piston(276) and it replaces with this the drug being beneath to them, which drug is emptied through the cannula into the tissue.

The conical narrowness is choiced such as to compensate the rubbing away of the wax envelope(276) at the wall without effecting a overflow of fluid. Due to the higher viscosity of the auxiliary fluid If there would event troubles more easily drug would be shifted upwards as auxiliary fluid downward. The clearance for motion of the dosing spindles on their connection strap(476) was calculated into the dosing extend. Together with the dosing spindles also the sliding valve is elevated and the its cross pin exceeds the short vertical distance within the oblique slot(267). The sliding coupling (269) permits the further elevation of the,

rod of the sliding valve and the activation of the reventilation valve. Such is effected by the movement of the covering carriage or slide to the right hand while the flaps open. Provided that the patient wants to correct the dosage after he has read the measuring results, so he holds both flaps pressed together so long as he desires the reventilation.

10 The Figure 29 shows in a longitudinal section an electrically driven injector with step syringes for two different drugs. The both step syringe cylinders are slipped in container cylinders(820). Above to the drug liquid the separating pistons
15 (275) are positioned, above to said the screwed mandrels(856) are positioned within protecting folded bellows(854) fastened to these and safeguarded against turning. The latter are driven on, shifted in height, by the inner screw of the
20 little gear wheels(839), which are driven on by the great gear wheels(859) above to the electrical motors(855). The lid plate(819) holds the gear wheels fixid to the housing. Whereas these motors are positioned behind the section plane,
25 the step syringes continuous with own cannula attachment piece each into the suction cup(173). Around the rims of this the three triggering pegs (853) are arranged, whose pressure contacts must be closed to start the compressor(830), which is
30 arranged behind the suction cup. The contact bars(858) for the cannula are operated by sticking one of these onto the respective cannula attachment piece. The central sensor pin(829) mediates the raising up of the skin by closing
35 of the contact what launches the injection. Generally, it is sufficiently to choice a kind of earth contact close without additional expenditure of power for the activation of a switch.

At both sides of the control housing(839) with the control unit the gear wheels(832) for the dosage choice are positioned.

5 The Figure 30 shows in a plan view the injector of the Fig.29. Additionally to the gears the fastening screw and the holding clamp(878) are visible. Further, the change-over button(834) for the run back of the motor, and such with aim
10 to lift up the screwed mandrels before the step syringe are withdrawn; further are shown the program changing switch(864) and the pressure switch (874) for the reventilation valve(875) with the ventilation channel(870). Additionally the posi-
15 tion of the battery(845) is given.

The Figure 31 shows a circuit diagram in TTL for Fig.29 and 30. Part A designs the energy supplying, (B) the choice of the dosing program,
20 (C) the check of the start conditions, (D) the programming of the dosage, (E) the restoration of the conditions at the beginning. By fixing of a cannula one of the contact bars(858) is operated and the appertaining contact is closed an in
25 part C the both AND-gates(1) compared for correspondance by means of TTL SN 7408 and the EXOR-gate TTL 7486. The circuit leads from there towards the AND-gate(2) TTL SN 7408, which interrupts the circuit to the compressor(830). If the
30 AND-gate on the suction cylinder or suction cup is closed three times (by positioning onto the skin), then the flip-flop switch TTL SN 7474 turns the compressor sucking by means of the transistor T(1). Now negative pressure is created in the suction cup through a suction tube; the skin is
35 lifted in the suction cup and thus activates the

contact bar(829) for its part and thereby it switches the NAND-gate TTL SN 7400 from the position low to the position high. In Part D for the choice of the stepping motor the stepping motor for the dosing screwed mandrel(856) or (856') is brought from low to high over the transistor(2), it depends from the position of the bistable relay; when the bistable relay and the compressor have been switched on. The trigger cam contact(856,856') is activated by every revolution fo the gear(859,859') and leads into the decimal counter TTL SN 7490. The comparison of the counter with the preselection switch occurs by means of EXOR-gate TTL SN 7486 with respectively classed with diodes IN 4148, until the flow of current has been switched at point E from high to low. The counter is set at the zero-position by low at E by means of the AND-gate(3). Over AND-gate(4) the compressor is switchet out; by means of AND-gate(5) the flip-flop switch is flipped into rest position. The transistor(3) insures by means of the switch-reset, that the bistable relay does not change its switch position because of the turning on and off of the device. The magnet reventilation valve(368) is activated by the monoflop TTL SN 74 1221 by means of transistor(4) for a duration which is predestinasted herefore in the course of which air enters into the suction cylinder or suction cup. For the reventilation, the inlet of air onto the suction cup also may be given free by activation of the pressure switch(874) through the ventilation channel(870), whereby the seat valve is opened by hand.

The Figure 32 shows in the longitudinal section a variation to Fig.29. The construction of the appa-

ratus is to be understood as follows:

Between the covering plate(2) and the cross-beam (884) of the housing(1), there are the square shafts(885,886) in their bushs(887,888,889, 890). The square shafts are secured against falling out by clamp rings; the square shaft(855) is connected to the driving shaft of the electric motor(855), and this driving shaft is connected to the compressor(830). The first great gear wheel(893) rests on the square shaft(886) and is carried along with it. The other gear wheels run on the bushs except for the last gear wheel (815), which is connected to the square shaft(886) and transfers in a retarded manner the revolutions to the dosing disks(816,325). This is done by means of a pinion(800), which is shiftable along the square shaft(886), and which is enmeshed in a bush(802) with inner teeth by means of a plunger case(890), which simultaneously serves as a pin shell is fixed by a latch(801) engaged within an annular groove (said latch being in a pulled position). Said bush is firmly fixed with the dosing disk(816), which works squeezing to the drug hose and its disk bearing by its rollers and which may displace the drug toward the cannula attachment piece. If the pin of the plunger case (890) is pressed the pinion is shifted to the right and engages with the inner teeth of the bush(820), which is fixed with dosing disk (325). Now is dosed out from the other supply container through the hose(44). After the starter lever(803) is pulled, the centrifugal force regulator, the weight burdened swivel arms(804) of which are drawn back from the prop of the cross beam(884), starts to function driven by the motor by the transmission of the square shaft. Therefore, the electrical switch contact(197)

is activated simultaneously with the operation of the starter lever. At the same time, the dosing, which is hollowed out in a pot-like manner, is shifted with its swivel arms along the square shaft surrounding the attaching head of swivel arms and it is pushed to the left against its adjustable spring. This spring mechanism causes, shortly after the number of revolutions of the motor has been reduced by the turning off of the motor, a blocking of the rotation of the swivel arms on the housing prop. The dosing occurs with control counting by the switch came (856) by means of the electronic control unit (175). The sealed housing is connected to the suction cup by the suction channel (809) and has the ventilation nozzle (869). The starting lever (803) and the plunger case (890) are sealed to the housing by folding bellows. There are contact pins (858) spring biased next to the two cannula attachment pieces. The sensor (829) is positioned between the the cannula attachment pieces and is activated by the skin which has been drawn up by vacuum. Three contact rods (853) for starting the motor are near the suction cup rim. The choice of programming takes place by means of contacts, which are activated by means of the end positions of the plunger case (890). The batteries are not shown.

Figure 33 shows a simplified electronic wiring diagram for this. The given voltage should be on the contact points which are designated 5 V, and the voltage of the entry gate-reset on the points designated R. Individual wiring as well as the diodes against locking currents are omitted for lucidity. After the switch for choice of program has been set for the dosing, the hand, acti-

vation of the switch-reset causes a slow build-up of voltage 5 V on a condensor, in order to bring the switch into the zero-position. The bistable relay of B stands on programs I or II and can be manually switched by the program change button. The pressure contact(858 or 858') is closed by the placing of the cannula on the cannula attachment cone and, in part C, compared for correspondance by means of the two AND-gate(1) TTL SN 7408 and the Exor-gate TTL SN 7486. The circuit leads from there to the AND-gate(2) TTL SN 7408, which interrupts the circuit to compressor (830). If the AND-gate on the suction cylinder or suction cup is closed three times (by positioning onto the skin), then the flip-flop switch TTL SN 7474 turns the compressor sucking by means of the transistor T(1). Now negative pressure is created in the suction cup through a suction tube; the skin is lifted in the suction cup and thus activates the contact bar (829) for its part and thereby it switches the NAND-gate TTL SN 7400 from the position low to the position high. In Part D for the choice of the stepping motor the stepping motor for the dosing screwed mandrel(856) or (856') is brought from low to high over the transistor (2), it depends from the position of the bistable relay; when the bistable relay and the compressor have been switched on. The trigger cam contact(856,856') is activated by every revolution fo the gear(859,859') and leads into the decimal counter TTL SN 7490. The comparison of the counter with the preselection switch occurs by means of EXOR-gate TTL SN 7486 with respectively classed with diodes IN 4148, until the flow of current has been switched at point E from high to low. The counter is set at the zero-

position by low at E by means of the AND-gate(3).
Over AND-gate(4) the compressor is switched out;
by means of AND-gate(5) the flip-flop switch is
flipped into rest position. The transistor(3)
insures by means of the switch-reset, that the
bistable relay does not change its switch position
because of the turning on and off of the
device.

Figure 34 shows in a sectional side-view a
medicine pressure bottle, the upper wall limitation
of which is drawn in a dish-like manner
into the folded bellows(831), that there is
room in the dish hole(822) for the bottle neck
together with the hose(44) which is wrapped
around the connection fitting(838), what allows
to pile up such bottles. A clamp clip(823) prevents
medicine or drug from flowing out into
the hose by gas pressure on the folded bellows.

Figure 35 is a lateral longitudinal section a
variation of the container, consisting of a
less elastic outer container which is filled
with pressurized gas. Within it, there is a
further membraneous container(408) with liquid
which empties solely through the hose(44), after
the clamp clip(823) is removed. The hose
is surrounded of a attaching plate(838) which
is sealed to it.

The Figure 36 is a schematical plan view showing a suction injector as a preferred elaboration of the invention. Inside the cannula magazine(262), which is developed as a spiral wound hose, the storage of stack cannulas of two different construction are seen in the longitudinal section. (The mentioned cannulas, which permit an automatic cannula change, are described in the Fig.48,49 more distinctly). The dosing is provided for two drugs or medicines, programmed and corrigable in dependence of the measuring results. The sectional planes for the following figures are given. It are demonstrated the cylinder(304) for accomodation of the suction piston, the inserting cylinder(334) with the dosing devices and with the drug supply containers, the hinge or joint(322) for the holding arm of the suction cup cover, the central bearing tube(314) for the cannula magazine, the guiding cylinder (313), the tube(319) for the pressure spring with the Bowden cable which leads back the suction piston, the protective tublet(320) for the tensioning end of said pressure spring and the pass tube(321) for the forth Bowden cable for the tensioning of the tension spring of the suction piston. The banderole(400) corresponds to a end of magazine prior to use. It holds the cannula back in the magazine means of a pin, which is stuck

through the wall, which cannula stay with its tensioned pressure spring with sealing bodies (370) on its ends.

5 The Figure 37 reproduces in the longitudinal section on the direction toward A - B of Fig.36 the suction injector during the suction cup cover is already closed and this is done before use. The suction cylinder(301) with tightly
10 grinded-on suction piston(302) in its interior is supported at its lower rim by the bottom cylinder(304) and at its upper rim by the cylinder (304) for the tensioning piston(405). The tension spring(306) which extends between the suction
15 and the tension piston and which is fastened at both is tensioned. The suction piston stands in vicinity to the annular piston(307), which is something shiftable along the central pin(308), which is fixed on the bottom cylinder, and its
20 permanent magnets -concentric arranged pin-type fixly inserted- contact on a annular socket ledge on the bottom cylinder with a iron ring, which is fixed there. The upper ends of the permanent magnets(309) are inserted in a soft iron ring(311),
25 which is sealing fastened at an elastic-membraneous septum(312). This septum divides the cylinder space in a greater upper and a minor lower part and is interrupted by the sliding non-return valve, into the afflux lead bore thereof
30 the sand filter(393) is pushed in.

Also about the central pin the septum is sealed by screwing. The central pin shows on its lower end a spindle-like swelling up with a flattened increase of curve above and a steeper below. The bending
5 spring(325) which works inwards with her power working even yet clings to the lower part of curve and the stop angle(327) is engaged by its pressure spring in a slot of the shell(369), which is fastened at the suction piston. The central telescopic tubes(328) between the suction piston and the
10 tensioning piston are extended asunder. The central blocking rod(329) is drawn downwardly after its spring is extended. Through that the blocking members(330) may be withdrawn from the obliquity of recess of the roof-top(331). The movement downwards of the tensioning piston is also blocked. The
15 rod of the reventilation valve(324) with the sand filter(393) is pressed from the annular piston. The suction cup(351) is arranged movable inside of the guiding cylinder(313) against three pressure
20 springs, whereby the downwardly movement is limited by the arreting spring(353) for the steering of cannulas by means of the triggering cam(355) of the triggering rod. Between the lower edge of the
25 suction cup and of the guiding cylinder an elastic sealing sleeve(352) is stretched. Along the three borings for the uptake of the pressure springs(334), to which the retaining arm(357) of the lid(342) of the suction cup counteract, the suction cup yet
30 contains the passage(359) for the triggering rod, which downward amplifies funnel-like, whereby its guidance permits by a certain elasticity of the holding arm(341) for the cover of suction cup to approach the intake tube(358) perpendicularly.
35 A little tube(459) which is shiftable onto that intake tube against a pressure spring, shows on his lower end claws(361) which anew work on to the cannulas through slots of the intake tube

by shifting. In counter position to the described
claws from the ends of the intake tube itself
spring claws(360) expand, which engage into the
ring groove of the cannula used atleast after the
5 spring biased tube(459) is shifted back by pres-
sing on against the central holding tube(314)
during the lid is closed, after that cannula was
depressed in lower position because the arretting
spring(353) was retracted by the triggering rod
10 (336) by influence of the pressure spring(Fig.26).
inside of the cannula magazine The lowering of the
tube(459) during the lid is closed also effects,
that the cannulas which are inserted below into the
intake tube, are pushed forward and upwards. If
15 the lid of the suction cup is opened the triggering
cam(355) passes the arretting spring(353) again,
through that the next cannula is able to be de-
pressed in a lower position. It than lies with the
lower edge of his body onto the arretting spring,
20 while the ring groove(381), which has a hollow space
connection to the cannula shaft, is positioned over
the boring for the angle(343) of the medicine supply
vessel in the cannula magazine. The prior used
cannula lying inside of the intake tube is removed
25 during the lid is opened, whereby the spring claws
(360) hinder them to fall out. Under the lid of
the suction cup at the holding arm(331) the
bayonet coupling(262) is shown
in the cross-section over the suction cup are
30 shown beside of the position of the cannula maga-
zine(316) inside of the central holding tube(314)
and the three pressure springs(354) and the pas-
sage(359) for the triggering rod and in both slots
(363) the both tubes with the angle(340) for the
35 supply of the medicine and inside of the central
holding tube the both electrical wires(364) from
the slide-contacts on the cannula towards the con-

by shifting. In counter position to the described
claws from the ends of the intake tube itself
spring claws(360) expand, which engage into the
ring groove of the cannula used at least after the
5 spring biased tube(459) is shifted back by pres-
sing on against the central holding tube(314)
during the lid is closed, after that cannula was
depressed in lower position because the arresting
spring(354) was retracted by the triggering rod
10 (336) by influence of the pressure spring(Fig.26).
inside of the cannula magazine. The lowering of the
tube(459) during the lid is closed also effects,
that the cannulas which are inserted below into the
intake tube, are pushed forward and upwards. If
15 the lid of the suction cup is opened the triggering
cam(355) passes the arresting spring(353) again,
through that the next cannula is able to be de-
pressed in a lower position. It then lies with the
lower edge of his body onto the arresting spring,
20 while the ring groove(381), which has a hollow space
connection to the cannula shaft, is positioned over
the boring for the angle(343) of the medicine supply
vessel in the cannula magazine. The prior used
cannula lying inside of the intake tube is removed
25 during the lid is opened, whereby the spring claws
(360) hinder them to fall out. Under the lid of
the suction cup at the holding arm(331) the
bayonet coupling(262) is shown
in the cross-section over the suction cup are
30 shown beside of the position of the cannula maga-
zine(316) inside of the central holding tube(314)
and the three pressure springs(354) and the pas-
sage(359) for the triggering rod and in both slots
(363) the both tubes with the angle(340) for the
35 supply of the medicine and inside of the central
holding tube the both electrical wires(364) from
the slide-contacts on the cannula towards the con-

trol unit.

in the cross-section on the right the position and the function of the bending spring(325) below the flask-like swelling of the end of the central pin (308).

5 The Figure 38 gives in a schematical longitudinal section along the sectional line C - D of the Fig.36 a supplement of the construction of the device. Inside of the cylinder(304) for the tensioning piston(305) this is lowered by the influence of the tensioning spring(306). The suction piston(302) inside of the suction cylinder(301) again lies below over the septum with the nonreturn valve (323) and the annular piston(307) whereby
15 the bending spring is engaged to the central pin (308) and the permanent magnets work. Below inside of the slide-in-cylinder(334) lay the both dosing mechanisms(337,338), whereby one of both elastic tubes with the angle(340) is shown. The slide-in-cylinder is held by a rail(336) on a ring around
20 the suction cylinder and pressed downwardly by the violent spring(335) under the stationary housing (315) with the control unit and the electrical battery. The both medicine supply containers lay
25 inside of the slide-in-unit and with it also against the lid(339) of the suction cup.

Figure 39 shows in a schematical overview toward even this lid of suction cup(339). Around the slide-in-cylinder is shown over it a winding of the
30 hose of the cannula magazine(316). The tubes with the angle(340) pierce the sealing sleeve(370) next to the central holding tube(314) into the suction cup. As the barrier(357) for the roof of the suction cup a bolt is drawn in.

35 Figure 40 shows in a schematical longitudinal section along the sectional line E - F on Fig.36 the position and function of the parts for the

preparation of the function of the suction pump
by the swivel of the lid of the suction
cup by means of the holding arms(341).
Immediately before the injection this was swiveled
5 out the position(shown by shared lines) during
the lid of suction cup is closed about 180 grades
about the hinge or joint(322) to close up the suc-
tion cup setting forth the functional stage which
is shown in Fig.37. Therby was by the tensional wor-
10 king of the bowding wire with the coat(344), which
is traduced inside of the protective tube(320) after
it is bent over a loop and which is finely connec-
ted at the end of the lever arm(345) with the hinge
or joint, the pressure spring(332) inside of the cy-
15 linder tube(319) tensioned during the lower guiding
piston(349) was lowered, without the last would been
able to transmit its moment of movement through the
bowden wire with the coat(345), which is fastened
on the centrally pierced upper guiding piston(349).
20 The upper guiding piston was already lowered with
lifting of the tensioning piston(305) during the
lid was closed. The tensioning piston thereby was
lifted by tension at the violent bowden wire
inside of the coat(346) from the end(347) of the
25 lever arm through the guiding tube(321). When the
tensioning piston is lifted inside of the roof-top
(also nearly to the upper end position of this) is
arrised thereby the blocking membres(330) was ur-
ged into the recess of the roof-top by the lowering
30 of the blocking rod(329) by means of tension from
the telescopic tubes, through that the returning
movement of the tensioning piston remains blocked
by the influence of the tensioning spring(306)
(as demonstrated in Fig.37). By self-winding up of
35 the corde-like end(348) which continues the vio-
lent bowden wire, the movement for opening of
the holding arm(341) has been released.

Figure 41 shows a partial exhibition of the functional stage after the tensioning piston is removed and the injection is performed. The lid(342) of the suction cup yet is flapped away. After the electromagnetic valve(324) for the reventilation of the suction cylinder(301) is opened, the suction piston(302) was drawn near to the highly positioned tensioning piston by the working of the tensioning spring(306). After the it was relieved from the tension of the tensioning spring(306) the blocking rod(329) was raised by the working of his spring, so that the blocking membres(330) has made away into the recess of the roof-top by working of the lower obliquity of wedge inside of the recess of the roof-top into the annual groove of the blocking rod. Now the pressure spring(332) was able to detend by pressing entirely downwards by means of the bowden wire inside of the coat(345) the tensioning piston (305), which was yet lowered by the influence of the suction cup and the tensioning spring(306). Finally the suction piston thereby fell in the influence of the permanent magnets(309) and the bending spring(325) engaged to the central pin(308). At the same time the stop angle(327) and thereby the suction piston was arrested against the arresting ball(366). The lowering of the annular piston(Fig.27?) had effected that the arresting ball made away into the niche destined for it. By the influence of the pressure springs(354) the suction cup(353) now was lowered in its guiding cylinder(313) against the skin. At the same time opened also the reventilation valve(324) by the stroke of the annular piston against the valve rod of this and the suction cup was reventilated by the bore for the arresting or catch ball(366) (Fig.37, with a low level of the tensioning piston as in Fig.38).

The Figure 42 reproduces the schematical functional process for the tensioning mechanism of the suction piston in the stage of the closure of the cover of the suction cup. The tensioning piston(305) is ar-
5 rised at its bow(531) by the violent bowden wire inside of the coat(346) towards its upper arresting position whilst its corde-like end(348) was extended during the the lid was closed. Therby the tensio-
ning spring(306) was tensed. The bowden wire inside
10 of the coat(344) was detended and thereby the lower guiding piston(349) with the detended pressure spring was lowered, whereby also the upper guiding piston(350) was shifted downwards by the bowden wire inside of the coat(345) in the cylinder tube(319).
15 To lengthen the lever arm of the holding arm(341) for the closing of lid of the suction cup may serve the extended telescopic rail(343).

The Figure 43 reproduces in the longitudinal section
20 a detail of a variation of the triggering mechanism for the suction piston, which allows to avoid the septum and the movable annular piston. Instead of the arresting ball(366) there is a rod(406) which is sealed by a folded bellows, which engages to a groo-
25 ve of the suction piston(305) at the left side. The bending spring(325) again brakes the raising of the suction piston by influence of the tensioning spring(306) at the club-like swelling of the central pin(308). The reventilation valve(324) is opened
30 by the support of the suction piston against the spring biased valve rod and therefore also the connection of the suction cup towards the outern air is opened by the channel(532) through the sand filter(594). The bore for the nonreturn valve(323)
35 expands parallel to the rod(406). If the suction cup is raised, its trough(365) comes in the area of the cap of rod, which entrates into this by influence of the obliquity of wedge of the groove inside of the suction piston which raises. Now the suction

cup is arrested whereby the partial vacuum, which forms inside of the suction cylinder, the air from the suction cup filtered sucks on through the air channel(533) during the nonreturn valve(323) opens. The reventilation valve(324) is closed and will be opened first again by the return of the suction piston during the suction cylinder is reventilated through the electromagnetic valve (which is not drawn in), while the reventilation through the air channel (533) until it is closed by the nonreturn-valve (323).

The Figure 44 shows schematically in the longitudinal section through the detail of the suction-cup-area a device and the function of the refilling of a supply container for drug at a device according to the Fig.37. The central holding tube(314) is shifted downward in its seal(534) on the cover of the suction cup. The relating drug support tube is withdrawn at its angle(340) out from the bore of the central holding tube and it is introduced in a bore of the plug-bush(535), while the other bore of the plug-bush is connected with the drug supply tube of the new supply container and that by plugging-in of the cone at the end of the hose(44).

Both dosing pumps are represented in the longitudinal section on Figure 45. From the supply bag(408) leads the drug hose(44) to its sac-like amplification between the pump cylinder(411) and the dosing-pump-pegs(337,338) and continues to the tube with the angle(340) which contacts through the cross-bore in the central holding tube(314) and through the cannula body with the cannula shaft. On the cross-section represented below along the line A - B of the Fig.45 nearly to the dosing-pump-pegs (337,338) the arrangement of the liquid pumps(409, 410,411,412) is recognizable.

On the Figure 46 the enlargement in the scale 5 : 1 allows to recognize more certainly the com-

position of the dosing pump. On the pump-peg builds
three annular grooves each a dosing chamber(416).
The hose ring(415) which is attached to it, is fi-
xed in the height in a groove-like bulge of the
5 axial bush(116). If the hose ring is blown up
this displaces the fluid out from the dosing cham-
ber and its environs and locks then the fluid
stream, whereby it leans to the edges of the groo-
ves. The fluid stream towards the cannula leads
10 through the channel(417). The fluid pump in the
Fig.46 builds a variation. From the three fluid
pumps for the auxiliary fluid attached each to a
hose ring, only one is demonstrated. Solenoid(413)
and resilient spring(414) work to the folded bel-
15 lows(418) according to the succession of pulses as
described next to that, which causes at I the in-
jection, while at II is effected a filling back.

20 In Fig.47 two fluid pumps serving to activate a
dosing pump as double-working piston-cylinder pump
are demonstrated in connection with the solenoid
(413) and the resilient spring(414), whereby the
both ends of cylinders are connected with at least
one hose ring. The middle hose ring(415) is con-
25 nected with each end of cylinders opposite by ho-
se. Fig.47, additionally, elucidates the pump
function. On the basic stage A both piston are
depressed by spring effect. The uppermost hose
ring is discharged from fluid, while the lower
30 and the middle hose ring are blown up by abun-
dance of fluid. On the stage B the uppermost hose
ring is blown up and the middle ring is relieved
and th both others are blown up. The impuls
series --, +-, ++ has the effect that a certain
35 quantity of drug is desplaced from above towards be-
low to the cannula and the fluid stream is locked

40 Figure 48 shows a stack-cannula(318) made of gumela-
stic material as Perbunane enlarged in a scale 3:1.

To use it special sealing elements especially around the entrance channel for drug or into the cannula magazine are not necessary. The upper and the lower chamber are connected one with other by a taille or incision which works like a joint.

5 The upper chamber serving as accomodation bore for the shaft of the adjacent cannula may be shaped comparatively narrow because bending of the magazine hose are equalized by its incision. The silvered stripe(382) expands as conductive path from the
10 bottom face to the cannula shaft. On the cannula shaft an enzymatic layer(383) is shown. The bodies of cannula may be pasted one up the other at its edges before used, so that the sterility of the
15 cannula shafts is guaranted.

Figure 49 shows an other stack-cannula in the longitudinal section. The cup-formed body of cannula(317) is divided in a lower chamber for the fastening of the cannula shaft(379) into the bottom plate of it and in an upper chamber to take up the cannula shaft of the following cannula by a separating wall. The upper chamber is closed off by the membrane(380) which is centrically pierced. Inside of the lower
20 chamber the cannula shaft bends angle-like(?) towards a annular groove(381) surrounding the body of cannula into which it is oppened. The annular groove has toward below an a steep surface, which supports the claws(361) of the cannula-intake-tube and it extends softly ascending upwardly and outwards.,
25 to fazilitate the transport of the cannula downwards, wherby the claws must leave the annular groove. The extend of the annular groove up to above of it has a stripe with a silvering, while the cannula shaft itself is platinized to transfer weak current without distortion of voltage to the contact spring at the central holding tbe for the cannula magazine. The body of cannula is made of casting plastic material as par example polyvinylchloride. The necessary annular seal inside of the central holding tube
30 (314, Fig.37) is not drawn. The enzymatic coat(383)
35
40

is drawn in. The further conduct of current takes place through the silverchloride-silver-layer of the arresting spring(353) provided to change cannula, while its underface is electically isolated to prevent the skin contact. On the other hand the use of a contact gel -as usual at the electrocardiography- is necessary to guarant the measurements. It may be used also a ring-formed electrode adhesiv on both sides(Fig.94), which is stucked on the suction cup rim and which is well conductive towards the silver-layer. By thus a adhesive conection the safety of application may be increased, solong as yet considerable reaction periods are necessary until the measurements are completed, because the maintenance of negative pressure inside of the suction cup is better guaranteed. The annular groove(582) in Fig.49 serves to the fixation by the arresting spring(353).

The Figure 50 shows above in the longitudinal section and below in the cross-section in the scale 5 : 1 the variation of a sensor cannula in a side-view. The cannula shaft is grinded off behind of the area of the yet closed point(541), so that the bore of the cannula would be open as trough(542). But the wall of the shaft was closed by the plastic insert(543) eith the isolating zone(544) towards the cannula shaft.

Figure 51 shows in the longitudinal section and below in the cross-section an other variation of the sensor cannula. Inside of the shaft is layed in a nearly capillary thin little hose(545) or a thread, the surface of which could have sensor quality. As into the others it may be possible that apart from blood also liquid of tissue may be sucked on by the capillary effect (or by application from suction from the drain tube.

Figure 52 shows a longitudinal section through the end of shaft of a sensor cannula, by which the wall at the point-area is thinned from the inside and

coated with the sensor layer(383), so that the last
not can be slipped off during it is stuck in into
the skin. The stability of the cannula shaft re-
mains conserved by the part with thicker wall.
5 In the inside of the shaft a little wire(577)
for the derivation of current is perceptible.

The Figure 53 shows in the longitudinal section
a sensor cannula similar as thus of the Fig.50.
10 But on the open trough(542) of the shaft is layed
in a little hose(545) or thread with sensor quality.
Because the operation of glucose specific enzyme
layers exceeds the possibilities of the inventor
was provided a electrolytes containing gel with
15 sugar-specific adsorbent for doting as coat to al-
ter the electrical conductivity on a platin cannu-
la connected with the measuring instrument.(Par
example the adduct sepharose-concanavalin A of
"Pharmazie" Freiburg-Breisgau).

20 The Figure 54 gives a photometric version of the
sensor cannula p.e. for the determination of gluco-
se, whereby the light source(560) and the optical
detector(561) and the cannula are shown in the
25 longitudinal section. Inside of the cannula attach-
ment piece(47), which surrounds the cannula shaft,
at least one fibreglas filament(885) leads from
that indicator layer back through the shaft. Around
the medicine applying end of hose with the cannula
30 attachment piece lies the contact-ring(587), from
which a fibreglas bundles lead back towards the
light source and other towards the detector. If
the cannula is introduced into the tissue than the
indicator layer responds to the glucose of tissue
35 changing colour dependent of the concentration of
glucose. The reduction of the light signals which
are led back may be evaluated according to a oaken
comparison to the measuring value. It may also two
fibreglas filaments lead towards two indicator

layers, which are charged qualitative differently, and backward, whereby the latter possibly are sensible for different time point of measuring and for different concentration ranks.

5 Such optical indicator layers are p.e. paper impregnated with glucose oxydase or peroxydase to which is added as color donator 3.5.5-tetramethyl-benzidin-dihydrochloride respectively
10 4-aminoantipyrin-dihydrochloride and natrium-3.5-dichlor-2-hydroxy-benzolsulfonate is added as color donator.

The Figure 55 shows in the longitudinal section a sensor cannula at which is brought on instead of a color indicator a half-moon-formed mirror(588) is
15 attached at the point-area of the inside of the shaft (the mirror may consists of silver steamed on, which is coated with silizium dioxide to protect it for oxydation.) At the left hand may be recognized a light conducting fiber(585) inside of a
20 cannula attachment piece(47), which is connected to a light source. The free light-ray towards the mirror, on which he is reflected through the liquid of tissue ba the other side of mirror and reaches a fiber of the light-conducting-bundle of the detector, is presented in dotted lines. The rotation
25 of the polarization plan by the glucose is evaluated by the computer.

The Figure 56 shows other features of the invention according Fig.55. To avoid the problematical and expensive optical coupling between the light-conducting-fibers inside of the cannula attachment piece and thus of the apparatus, the light-rays are projected from the sectoral disk(589) directly through the middle-bore of a stack-cannula
30 (317,p.e.) into the cannula shaft and received also from there on the part of apparatus and transduced towards the detector in light-conducting-fibers
35 (885).

The cannula bore is closed up downwards by the window-membrane(590), which lets through the rays, but not the medicine. The last is injected side-ward from the annular groove(381) out from the medicine-outlet-opening(440) through the holding tube(314). If the injection is completed, by lowering of the sectoral disk(589) the adhesive-centralized cone(594) is withdrawn out from the central bore and the by swivel around the (only out-lined) axis according to a transport carrousel(211) the passage of the next cannula is given free. The mirror(588) may be steamed up with silver or aluminium as thus of Fig.55.

The Figure 57 shows in a lateral view and below in a cross-section a part of the control rings for the electronically programing of an injector as it is described on Fig.36-44. On the switching ledge(371) of the controller housing cylinder are to neighboring pressure contacts in pairs for one controlling ring(372), which are operated its inner bounds of the controlling rings being shaped undulatory one after the another following of each excavation and that as the direction of turning may be in the opposite sequence, whereby the ball catch(373) guarantees to shift these only by entire switching steps. By binary coding now the singular parameter as tissue-sugar-values or amounts of insulin may be perceived at its respective debit and nominal values for dosing and they may be represented and evaluated arithmetically. For the praxis already 20 switching steps seem to be sufficient, for the timing the hour-spaces with intervall between 0 and 5 hour clock (whereby an inversion of day and night may be equalized by conversion of the timer), concerning the tissue-sugar-levels in milligramm percent 20,30,40... until 100, than 120,140,160...until 300, than 350 and 400, concerning the amounts of insulin, in units 4,8,12...80 further concerning the multiplying constant (K1 for retarded insulin and K2 for immediately

working insulin) the switching steps 0,1,2,3..untill
19. as reference lines for the reading serve projec-
tions of edges on the intermediate rings(374) which
are fixed upon the controll cylinder, a wire-bent
5 or at its place a transparent plastic strip with
the effect of optical enlargement will also serve,
which may be turned away from the reading area,
so that the elevated-shaped numbers may be
reprinted for the registration. Salient edges(376)
10 facilitate the turning og the control rings and hin-
der a turning over towards one direction. Neighboring
control rings, which are functionally adjusted,
may show a pin(377) with a hook-like angle, which
bumps against the edge(376) and thereby effects an
15 automatically taking along one with other. 4 program-
blocs (I-IV) are recommended which are composed each
likely related to four preprogramable dates of ap-
plication with an graduated in hours preeligible mini-
mal distance supplement bloc(V) exclusively for the
20 additional application of immediately working insu-
lin in particular to equalize mistakes of diet or
of adjustment, wherby it remains as the task of the
medicin to adjust the dosing of retarded insulin
reasonable.
25 The Table 1 shows a composition of example-like pro-
grams and of the effects of these on the treatment
of insulin. It is concerned of patients with appli-
cation of insulin at the morning in the lowerst until
the highest dosages recording to a quite different
30 sensibility for this therapy. According the time-
table no statements are given, the extent of tole-
rance of the debet-sugar-level was fixed a
90 to 120 milligram percent at a ideal value of 120
milligram percent. also the measured actual va-
35 lues for glucose are simplificated with once 180 mil-
ligramm percent and another with 50 milligram per-
cent. Solely the correcture factor K2 for retarded
insulin was varied by assessment and a correction
with immediately working insulin was not comprised.
40 The column of dosing correction, which is attended

by the computer, is represented for elucidating. The result of the correction, which consists in the case of the sugar level of 180 milligram percent in a increase and in the case of 50 milligram percent in a depression of the original doses, is evident from both vertical rows of numbers. Patient 2 theoretically have to keep at a blood-sugar-level of 180 milligram percent 56 units retard insulin in addition, but what is not possible, because the maximum dosis is exceeded, but leads to the supplement program V with immediately working insulin. The same patient gets whatever no insulin if the sugar level is 50 milligram percent. A patient which is endanged by under-sugar urgently must be advised to eat and to inject before the meals, to avoid supplementary applies of immediatiely working insulin. On the other hand a other in the purpose to incorporate a rich meal can defer the injection towards a time after the meal and thereby obtain additional units of immediately working insulin. Even if the programming should be taken to task by the physician and therefore it's provided a blocking of the rotation of the control rings by the pressure of a screw(384) which may be activated by key, what is promoted by ribs(383, Fig. 57) on the plane sides of the control rings, nevertheless the patient has a lot of duties to cooperate and possibilities to influence, what also results from the description of synopsis of functions. Such a synopsis of functions, therof every trained expert is able to derivate a electronical block-diagram without difficulty, Figure 44 reproduces. Below with rectangles and circles the organs of functions are shown, as the timer(386), the suction cup(173) with cannula during the earth contact by means of the skin wich is drawn up by negative pressure, there are also reminder and warning devices(387) with the functions as acoustic and optical signal and vibrator, to facilitate the

use by handicapped persons (all separately to
switch off by hand switches 1/0), and the elec-
trical measuring instrument with display and
printer(389) and display and printer for the deli-
5 vering units of retard insulin(390) and for immedia-
tly working insulin units(391) and the dosing pumps
(337,338). Over these inside of the rhombs lies
the adjusting range of the control rings, inside of
rhombs and rectangles with shared lines the measu-
10 ring data of the actual glucose levels and its pro-
cessing by computer. The timer gives the respective
hour through the line(a) towards the clock for
the comparison. A computer element there determi-
nes, how much before and after the clock-time
15 and after yet works a signal from the measuring
instrument(388) in the direction of the pumps
through the line(b). Always free is the path of
the line(d) from the cannula towards the measu-
ring instrument(388) and towards its display and
20 printer.
In the case of failure of the measuring instrument
the patient has still the possibility to call off
the normal dose by the hand switch(390) in the line
(c). The adjusted clock-time is activated through
25 line(e) of the warning device(337). If the assigned
period for a treatment already was passed over, the
succeeding program is chosen on, what also is pos-
sible, if the program I is switched off on the hand
switch(391). Programm II being also switched off
30 by hand a dosing is not effected. The possibility
to choice between two programs at the same time
point increases the adaptability between the mode of
living and the treatment. After the programing of
time follows (read from the left hand to the right)
35 through line(g) the nominal-value-program for the
tissue-sugar-level with the desired ideal value
in the middle and the limiting values above and be-
low, during these are reached no dosing correction
should taken place, the shared vertical lines with
40 arrows symbolize that arithmetic statement

of the allowed deviation by the comparison from
the preprogramming. The fourth lowest rhomb marks the
(dangerous) extremely lowest value, from which leads
a stopping signal during recording through the line(h)
to the both pumps. If the sugar values lies higher
so leads the line(i) farther into the direction of
the dosing programs. When the measured sugar is lo-
wered below the incorreced admitted value, the
hight of the reduction from the retard insulin units
is ascertained by arithmetic ascertainment of the
deviation from the fixed ideal value and multiplica-
tion with the fixed factor K1, which is destined
by the distance of the lower rhomb from said normal
dosis, and after these are deduct from the normal
dosis according line(k), display and registration
are effected and dosing through line(l). Through
line,m) the delivery of immediately working insulin
thereby is switched off. If the sugar values are
measured as inside and upwards of the allowed to-
lerance the line(n) effects the program for the im-
mediately working insulin to be switched to, whereby
a eventually pre-programmed delivery of immedia-
tely working insulin is stimulated according to the
arithmetic comparison between an excessive value
and a nominal or ideal value after multiplication
with the factor K2 through line(p) is effected.
If the preprogrammed maximum dose is exceeded he-
reby, so is made a note of the supplement program
through line(q), which effects the remembrance by the
warning device inside of the limitations of time
programmed there and which may be applied. Through
the line(u) the electro-magnetic valve at(368)
is opened for reventilation. Reventilation is also
effected through line(v) after the exclusive mea-
surement of the tissue-sugar-level without a deli-
very of insulin(p.e. outside of the fixed limita-
tions of time or according the intention of the

of the allowed deviation by the comparison from
the preprogramming. The fourth lowest rhomb marks the
(dangerous) extremely lowest value, from which leads
a stopping signal during recording through the line(h)
to the both pumps. If the sugar values lies higher
so leads the line(i) farther into the direction of
the dosing programs. When the measured sugar is lo-
wered below the uncorrected admitted value, the
height of the reduction from the retard insulin units
is ascertained by arithmetic ascertainment of the
deviation from the fixed ideal value and multiplica-
tion with the fixed factor K1, which is destined
by the distance of the lower rhomb from said normal
dosis, and after these are deduct from the normal
dosis according line(k), display and registration
are effected and dosing through line(l). Through
line(m) the delivery of immediately working insulin
thereby is switched off. If the sugar values are
measured as inside and upwards of the allowed to-
lerance the line(n) effects the program for the im-
mediately working insulin to be switched to, whereby
a eventually pre-programmed delivery of immedia-
tely working insulin is stimulated according to the
arithmetic comparison between an excessive value
and a nominal or ideal value after multiplication
with the factor K2 through line(p) is effected.
If the preprogrammed maximum dose is exceeded he-
reby, so is made a note of the supplement program
through line(q), which effects the remembrance by the
warning device inside of the limitations of time
programmed there and which may be applied. Through
the line(u) the electro-magnetic valve at(368)
is opened for reventilation. Reventilation is also
effected through line(v) after the exclusive mea-
surement of the tissue-sugar-level without a deli-
very of insulin(p.e. outside of the fixed limita-
tions of time or according the intention of the
patient). Through the pressure switch(392) the pa-

tient is enabled to interrupt the commanded run
down into the direction of the injection after the
skin is sucked on and during the measuring. If he
releases the pressure switch after the ascertain-
ment of the measuring values, so is effected (yet a
5 little delayed) the injection. But if he activates
the pressure switch after a short interval
a second time, so the injection is broken off fine-
ly by reventilation. The consumption of medicine is
10 controlled by the additive counting of the respec-
tive delivered amounts by the single pump and it may
be questionable through the lines(w,x). After the
preprogrammed consumption of amount registration and
alarm is effected through the lines(r,s). Also the
15 consumption of cannulas is reported and registe-
red through the counter after contact-countering at
the contact(392) in the area of suction cup accor-
ding the activation by the gear pin through line(t).
Concerning to the construction of the sensor cannu-
20 la the invention is supported by the following
publications and by the publications cited there:
1. Implantable Glucose Sensor, E.Wilkins and M.G.
Wilkins; J.Bio.med.Eng.1983,Vol.5,October,309-315.
2. Problems in Adapting a Glucose-Oxydase Electro-
25 chemical Sensor Into An Implantable Glucose-Sensing
Device, Daniel R.Thevenot, Diabetes Care,Vol.5
No.3, May - June 1982, 184-189.
3. Progress Towards an Implantable Glucose-Sensing
Device, David A.Gough, John K.Leyboldt, and John C.
30 Armour: Diabetes Care, Vol.5 No 3, May - June 1982,
190 - 198.
An electronical delaying of a renewed printing pro-
cess may noted down with continuing transport of the
registration belt to hold readable the printed out
35 dates. More advantageous (by reason of the energy-
saving) is the running after of the registration
belt according the elapsed time during the use. It
It is provided also a program automatic, to' settle

evident wrong decision by the part of the physician,
which again and again make necessary equal dosing
corrections. Such a program automatic is also ad-
vantageous also than, if the life conditions of the
5 patient change without the possibility to call on
medical help. At short notice also the reasonable
patient must become the possibility to vary the insu-
lin doses within the free zone which is fixed by
the physician. By means of the (lockable by the
10 physician) key(586) the patient is enabled to add
impulse-like or cycle-like supplementary immedia-
tely working insulin for the injection, so far as
he carries out that within the next minute after
the command. The absolute hight of the whole sup-
15 plement dose known to be limited by the physician
within the free zone which is narrowed anyhow.
For the commands, which limit the choice by the
patient, is provided a separate control ring.
G.e.its position 1 means = Blocking of the program
20 automatic (see below) for immediately working in-
sulin, 2 = Blocking of the program automatic for
retard insulin, 3 = Blocking of the entire program
automatic, 4 = Limiting of the supplement dosing
upon 15 cycles, 5 = limitation upon 10 cycles,
25 7 = Blocking of the supplement doses, 8 = limita-
tion of the supplement dosing upon 15 cycles and
blocking of the program automatic for the immedia-
tely working insulin, 9 = Limitation of the sup-
plement dosing upon 10 cycles and blocking of the
30 program automatic of immediately working insulin,
11 = Blocking of the supplement dosing and of the
program automatic for immediately working insulin,
12 = Limitation of the supplement dosing upon 15
cycles and blocking of the program automatic for
35 retard insulin, 15 = Blocking of the supplement
dosing and of the program automatic for retard
insulin, 16 = Limitation of the supplement do-
sing upon 25 and blocking of the entire program

automatic etc. A decode disk(595) is affixed on the lid of the device, whereby that is revolving suitable as control ring itself. Relating to "Program automatic" an installation means . which performs a correction of wrong decisions for the compensation of dosing. If is called off four times successively with the same time-block, so the retard insulin dosing is increased in each case for 1 cycle for the time point, which walk ahead to the measuring time points. If the programmed correction dose reaches the adjusted maximal value without full compensation (if also a additional injection is requested from the block V), so the retard insulin dosing of the preceding time block is increased by 2 cycles. The increase is effected within each time block now on each occasion after measuring. If the lower limit for the dosing correction fell short during anyone use of the device, so a shortening of the retard insulin dose results for the time block, which preceeds to that time point. When the lowest limiting value for the dosing stop is reached, so shortening of 2 cycles results, so far as the supplement programm V isn't activated during the elapsed two hours.

To activate the program automatic for the immediately working insulin the cooperation of the patient is necessary. By the operation of the program button(597) the allotment by the time block is disengaged and called on block V, as far as an injection of retard insulin not resultet during the last 6 hours. The patient shall taken on a meal with 3 bread units of hydrocarbons, which are readily to resorb, about within 15 to 20 minutes before the button is pressed and it is requested that he effects the controlling measurement within 15 to 20 minutes after the dosing of immediately working insulin is resulted, the hight of which relates to the preprogrammed correction prdgram. If the measured-(actual)-value exceeds the ideal-(nominal-) value, so the dosis-correcting-factor(K2)

is increased for 1. If the actual value falls short of the nominal value more than 20 milligram percent, so the dosis-correcting-factor(K2) is lowered for 1. By the display the patient is called on in all cases of correction to repeat the testing of program
5 some time. The state of the real position of program (deviating perhaps from the starting position, which is readable by the position of the control rings) will be rendered visible by a little
10 turning-motion on the control rings concerned upon the classed field of display. The physician is able to render visible the altered values of programs also by the position of the control rings by readjusting of the control rings after these are spaced
15 back beyond zero (whereby the both contact pegs of the switching ledge(371) are activated simultaneously that the edge ring(316) which is supported to each control ring(372) is revolving arranged towards the prior, whereby the extent of the movability or clearance is limited by the blocking
20 peg(275), which inserts from the edge ring through a slot on the carrier-ring to a distance downwards of the interval of the singular stops of the snap-in ball(373). The sliding contact(226) at the wave-
25 summit of the inner profile of the control ring meets the contacts(598,599) of a switching ledge on the housing cylinder(315) and closes the contact towards the control unit. The reset-spring (600) between the edge-ring and the control ring
30 interrupts then again.

It must be distinguished according the activation of the program automatic for immediately working insulin, whether the adaptation of the correcting factor for program V to the relations of metabolism is proposed (and this kind of correction have been represented above) or the preprogrammed amounts of immediately working insulin of the singular blocks should be altered. The correctional last supplement dosing of immediately working insulin in addition to the doses of retard insulin (exceptionally also the dosing of immediately working or unmodified insulin alone)

is effected automatically, if the patient applies again the injector 15 or 20 minutes after the injection (So far as correction is not blocked).

Description of the program operation:

In the loop of the main-program(MP) is questioned, if the cannula has skin contact(1), so that the measuring may begin, or if the clock-time(2)

of a active time block is reached, so that the user must made attentive (by alarm signal),

whether the user desires(3) a displacing(8) of the time blocks, whether(4,5) one of the supply container must be charged(9,10) to the value of a

new container(Fig.59).

The operation(12) of the intern clock and of the controll ring contacts(13) is so time critically, that it interrupts the main programm if needed (Fig.60).

The Fig.61-64 are a refinement of the block(6).

After the measuring(14) is decided, whether the program automatic for the instantly working insulin should be effective. If that is not the case and the time not lies inside of the time window(20) of

the programs I-IV and the user not pressed the button(21) "program V" during the next 15 sec.(23)

or if of course program V is selected, but the blocking time after the last injection is not yet transgressed(22), so the process is broken off

by reventilation(18,19) (Fig.61).

If the choice(24) between two programs is possible, than the position of the switch for program choice is questioned, unless it was taken a decision at the same day. If the measuring value lies not in tolerance window, so a correction(27,28) of the insulin doses is effected. If the measuring value is transgressed the function blocks 27,31 to 35 follow. Besides the program automatic for retard insulin either 29,30 or 31 to 35 is effective, unless it was locked(29,31) by the physician(Fig.62). The injection events after 15 sec.(41), if the user not activates the key or button "waiting". A twice repeated pressing(37) of this button effects the break off(42,43) of the injection. With button "+" and "-" the dose of instantly working or unmodified insulin may be altered(44,45,46). In the case that the supplies resting after the injection are not sufficient(for an injection with full dosis, the user will be invited to pump(56,57) the differential quantity into the supply container. If, during 15 sec. not any button is operated and the skin contact still exists and the insulin supply is sufficient, the injection will be performed; in the other case the interruption by reventilation(51) will be effected. If the skin contact continues inadvertently, the device remains in an attending position(52, Fig.64).

Figure 65 is a longitudinal section of an embolism operated by spring action, wherein a hose roller pump is employed as dosage device. A mounting plate(4) above the fixing tab or tongue(3) is attached as outer support or abutment for an exchangeable or replaceable cylindrical vacuum reservoir cuplet(5) at the housing cylinder(1) above the covering plate(2) closing said housing cylinder. It has a cover in the form of a membrane(6) about the aperture conus of the cannula located at the center of the rod or pin(7) and extending further with its free end(8) in the shaft of the cannula, which end is surrounded or enclosed by the annular piston(9). The border membrane(10) divides the cuplet into the space of vacuum reservoir(11) and the suction cup(12) while comprising the predetermined breaking grooves(13). At the mounting plate(17) the support ring(15) is affixed by means of four screw pins(14). On the opposite side of the housing cylinder above the base(16) the base plate(17) is mounted parallel to said support ring(15) and to the mounting plate, which mounting is effected by means of a slide-in or plug-in locking mechanism(18). The base plate supports the container cylinder(19) having a lateral slot for inserting the drug or preparation supply bag(20). A cam engages across the angle bracket(21) from the base plate into the longitudinal groove(22) of the sliding sleeve so as to prevent it from being rotated. A tang of the dosage disk(25) effects in the sliding sleeve (23) thereof its rotary motion. Clamping pins or set pins(26) are uniformly spaced about the circumference of the dosage disk, wherebetween spring steel tabs(27) are locked at the tripping pin or rod(28). The drive of the dosing disk(25) for displacing the sliding sleeve is transferred via the tube segment(29) onto the disk with

detent(30) and onto the spiral spring(31). The
detent or pawl(30) acts upon the pawl wheel(32)
on the tubular collar(33). The pinion(34) moun-
ted thereto actuates the counter, engaging the
5 gear rim of the counting wheel(35) located be-
hind the plane of the projection and held by
means of a compression spring(36) against a sup-
porting lamella(77) at the housing cylinder.
Spring-suspended pins or rods on the counting
10 wheel(38), the compression spring(39) of which con-
tacts the supporting wall(37), effect that the
counting wheel(38) is rotated via frictional con-
tact with the pinion; an escapement on the suppor-
ting lamellas(77) allows via the actuation by a
15 tripping pin onto the counting wheel(35) but one
rotation respectively about one of a hundred
teeth in the counter(78) after the counting wheel
(35) has effected one revolution. The exhaustion
of the drug or preparation supply is approached,
20 a spring suspended pin, which has a divergent cen-
tral spacing, snaps into engagement with the bore
of the pinion and blocks also the rotation of the
dosage disk(Fig.70). The force of the spiral
spring(31) is transferred across the tubular col-
25 lar(33) onto the carrier disk(40) for the axes
of both rollers(41). These rollers are urged by
two spheres housed respectively in two tubular
sleeves againsts the hoses(44), the recessed
ring(43) serving in this conjunction as abutment
30 which comprises a gab thereunder for the passage
of both hose legs of shanks. In this section
the hoses are coated up to the T-member(46) compri-
sing the cannula attachment piece(47) with in-
extensible envelope(45). The hose ends are stret-
35 ched by means of tension springs(48) at locations
where the emerge from the pump. The pumping unit
is displaceable along the sliding sleeve on the
tubular collar(33) against the action of the com-
pression spring(49). (The appropriate pin or rod
40 originating from the carrier disk(40) in the asso-

ciated cross slots in the tubular collar have not been represented in the drawing). The sliding motion is carried out by means of four vibrator pins(50) arranged on an annular prism profile on the exterior of the carrier disk (Fig.72). These vibrator pins are flush mounted in the disk(51) being rotatable independently of the tubular collar and engaging with a cam, the spiral slot of the axle driving shaft (52) at the free end of which there is located a foot plate(53), and at other end of which there is mounted a cam pin or follower(53) engaging the longitudinal slot of the sliding sleeve and preventing rotary movement of the axis or shaft. The spiral spring(55) serves the purpose to drive the disk(51).

Figure 66 is a cross sectional view along line A - B of Fig.65, showing the mechanism of the dosage adjustment. Three spring steel tabs(27) originating from the disk rotatable on the tube segment(29) are disposed between clamping or setpins(26). One of the spring steel tabs contacts the tripping pin(28) for dosing after having passed the wedge profile ridge(56) of the release mechanism for reventilation(Fig.68). Two of the spring steel tabs represented are disposed in a type of blind or blank zone of the rotary sector of the dosing disk(25), as resulting from the necessity of supporting the spiral spring at the housing cylinder(1) and from the feasibility of manufacturing the slots in the sliding sleeves(23).

Figure 67 is a cross-sectional view along line C - D of the dosis counter indicating the consumption of the drug or preparation, and the locking means for preventing the use of the injector subsequent to the exhaustion of the

supply of the drug or preparation. The pinion(34) is mounted on the tubular collar(33) for driving the counting wheel(35). A cam pin or follower mounted thereon actuated, after respectively one
5 revolution, the spring-suspended locking escape-ment or armature(57) effecting continued rotation of the large counting wheel(38) to the extent of width of tooth under influence of friction of the pins recoilable by means of leaf-typed springs. One of these pins has a different spacing to the
10 toothed wheel center and is pushed by means of compression springs(39) into a bore of the pinion (34) as soon as counting wheel(38) has carried out one complete revolution, which corresponds to the exhaustion of the supply of the drug or
15 preparation.

Figure 68 is a tangential sectional view along line E - F of Fig.65, showing the releasing or tripping mechanism for reventilation and for do-
20 sage dispensing subsequent to vibratory action. The spring steel tab(27) has surmounted the wedge of the wedge profile ridge or ledge(56) at the point in time illustrated. Said ridge or ledge had been returned by means of compression springs
25 (64). The slot guide(65) with the slot pins prevents that they will slide off laterally under the action of the leaf-type springs(63), permitting the ratchet rack(62) to engage the ratches of the small toothed wheel effecting thereby its
30 revolution. Co-revolution of the large toothed wheel(58) connected to the small toothed wheel has the effect that the saw teeth thereof engage the sliding pin(59) in a slot of the release or trippingbar at a point in time when said bar is
35 raised(as shown).

To the right of Fig.68 a disk(51) is shown in an enlarged scale of 2 : 1. This disk carries the vibrator pins. The illustration is shown in greater detail so as to give an appropriate presentation of one of the four passages or penetrations
40

wards (and with its position later on). The ram-
mer extends further through the passageway(70)
into the drum(71) which is provided with the de-
pressed connecting link guide(72) into which the
fixing screw(73) of the terminal plate(12) pro-
5 jects. The housing for the drum has been omitted
for the sake of clarity, just as the housing for
the wedge(75) for blocking the vibrator pin(50).
A cap or cover(76) is placed on said wedge, which
cap is elastically hinged and lets the the vibra-
10 tor pins pass when the disk rotates clockwise
however, not the case when the rotation is coun-
ter-clockwise. Said wedge is provided with an ob-
lique slot(77) for accomodating a wire stay or
15 strap(78) the square axis of which is rotatable
within the pivot bore(79) of a slot in the spring
-suspended connecting pin(80). The tripping notch
(86) in the shaft above the drum is turned away,
corresponding to the position of the fixing screw
20 in the connecting link guide, from the transverse
pin(87) of the wedge, which action is even rein-
forced when the drum is raised and rotated along-
side of the connecting pin guide, When urging the
vacuum reservoir cuplet all the way up, the fee-
25 ler angle pivots about 90 degress and comes to
rest on the rim of the pin(7) about the shaft of
the cannula. A lowering of the drum is thus pre-
vented. The rammer rotates, likewise, and takes
up its place now, turned onto its narrow side,
30 laterally of the wall of the cuplet, coming down
by passing thereby. The tripping or release me-
chanism for reventilation is comprised of a trip-
ping bar(60) having a compression spring and of
a bay(88) preventing rotation and disposed bet-
35 ween a mandrill(89) guided in a bushing and an
attachment underneath the drum(71). In contra-
distinction to the illustration of Fig.68 the
sliding pin(59) is not yet in rest position
within the tripping bar(60).

(67) into which the round dome of the tripping pin(28) may escape under the influence of the oblique positioning of the spring steel tab to order to be returned onto the disk surface via an obliquity and after passing the steep flank. In this manner, the movement of the dosing disk up to the stop of the next spring steel tab has been unblocked.

The Figure 69 is a simplified view in cross section along line C - H of Fig.65, showing three back-up buffers(81) being both guided by means of a spring steel stay(82) towards the wall of the vacuum reservoir cuplet and being pressed by means of the compression spring(83) against its projecting rim. A pivoting lever(84) is employed for removing again the cuplet connected in this manner. This lever(84) forces a wedge in between the mounting plate(4) and the cover membrane(6), which will become more clear when inspecting the partial longitudinal section shown below said cross section.

Figure 70 is a view in cross section taken along line J - K encompassing the center of the vacuum reservoir cuplet towards J. It shows the mechanism for tripping the vibration means and the tripping or release means for reventilation of the vacuum reservoir cuplet. The abutting or support ring(15) is constructed in this connection as modification to a conductor cylinder leading upward so as to facilitate the introduction of the vacuum reservoir cuplet. Said ring is provided with a lateral slot(68) through which a flattened loading stick or rammer(69) reaches down. The broadside thereof is shown in the illustration, with the lower edge of the wall of the vacuum reservoir cuplet(5) being supported while the feeler angle extends rear-

In Figure 71 the cross section taken along line L - H in Fig.65 shows the position of the hose between the rollers(41) and the grooved ring(43). A sectional view through the dosing disk(25) in the direction of the arrow shows thereunder its profile cavity for accomodating both hoses.

In Figure 72 the projection shows the vibrator mechanism of Fig.65, wherein four vibrator pins(50) effect, on the disk(51) with its revolving motion relative to the wedge profile ledge or ridge(56) of the dosing pump, their jerky displacement against the compression springs(49).

For the device to take up its operation in keeping with Figures 65 to 72, the plug-in or slide-in locking mechanism(18) is drawn, whereupon the shaft can be drawn out from the sliding sleeve. The injector is then disassembled into a right half comprising the covering or terminal plate (2), mounting plate(4) and screw pins(14) together with the support ring(15), the pump unit inclusive of the grooved ring(43) may then be drawn off from the tubular collar(33). After bending out the ring(43), the hoses in the profile cavities of the dosing disk may be slidngly introduced and the emerging ends of the hoses may be connected up to the tension springs(49) at the onset of the envelope(45). The drug or preparation supply bag(20) is introduced into the container cylinder(19) via the slot provided thereon. Said cylinder is with its attachment part of the left injector half which must be approached once more by assembling the component parts. (The detent or blocking pin- which has not been incorporated in the drawing- must be inserted in its longitudinal slot in the tubular collar(33). The cannula adapting or attachment piece(47) is plugged through the bore of the attachment plate, closing, in the end, the plug-in or slide-in

locking mechanism(18). The dosage is then preselected by slightly raising the spring steel tabs (27) and rotating them in the intervening space between two clamping pins(26) each, which space
5 being designated by numerical markings.

By exerting pressure on the foot or base plate (53) at the end of the shaft(52), e.g. on a table or squeezer plate, the disk together with its
10 vibrator pins(50) is moved across the wedge profile ridge or ledge(56), the cap(76) letting the vibrator pins pass by resiliently avoiding them, doing so up to the highest tension of the spiral
15 spring(55). The movement cannot be reversed on account of the presence of the wedge(75). By exerting pressure on the sliding sleeve(23) the spiral spring(51) is loaded, without this movement being transferred to the pump by virtue of
20 the detent or pawl(30). The spring steel tabs slip -elastically evasive by virtue of the obliquity of their ends -over the end of the tripping pin(28) and the wedge profile ridge or ledge(56), with the spring steel tab -locked by the tripping
25 pin- for the first dosing comes then to a halt in front of the tripping pin by pushing back the wedge profile ledge which can be displaced only inwardly towards the compression spring(64) after the tripping bar(60) has been raised, the
30 notch of which unblocking the movement of the large toothed wheel(58) via movement of the sliding pin. This comes about after a vacuum reservoir cuplet has been inserted by raising the rammer up to its rotation about 90 degrees of-angle above the connecting link guide(72) on the drum.
35 The notch(86) circumvents -by overtaking- the transverse pin(87) to come to rest thereabove on the shaft above the drum. When effecting an application and setting the support or abutting ring(15) down on the skin, the annular piston is
40 raised, by exerting heavy pressure on said pro-

compression springs from the edge or end slot,
blocking its motion and comprising a terminal arm
parallel with wire strap. into the pivot bore(79)
and drawn out laterally from the oblique slot
5 (77). By the way of the slot guide (not illustrated in any particular detail) which is devised
so as to be more and more restricted and located
in the connecting pin it is assured that the retaining clip returns when compressive-load is applied to the perpendicular line(Fig.70). Subsequent to exchanging the drug or preparation supply bag the counter has to be reset to zero. To this purpose, the counting wheels(35,38) may be respectively unblocked antagonistically from
10 tooth wheel engagement against the compression springs associated therewith, whereupon they can be freely rotated.

Figure 74 is a schematic diagram at a scale of 2 : 1 of pairs of antagonistically operating rollers(41), the outer counter rollers(90) in this
20 example are edling and rotated passively, an operation facilitated by their rubber elastic surface. Two rollers each are attached by axes to a common pivot arm(91), the drive being effected via a pinion turning on a larger toothed wheel
25 (92).

In Figure 75 showing a full size schematic sectional view from above (somewhat in the direction of the arrow towards Fig.74) a dosage pump is illustrated. It is shown here a feasible manner of hose lay-out with a hose pair while using roller pairs as in Fig.74, both of which hose legs departing laterally and thus solidely contacting the carrier disk(40) in that herebetween a toothed wheel is disposed having notches between
30 which threads(94) bridges over both hoses(44) in a rope ladder-type manner.

Figure 75 is a modification of the embodiment shown in Fig.65 to 74, the difference over said

jecting annular piston, to an extent such that the predetermined breaking lines(13) of the border membrane(10) will break, whereas the suction cup rim will already close off the skin about the suction cup. The negative pressure effective from the reservoir raises the skin into the suction cup, and at the same time, however, the pin approaches the skin(Fig.88), which has lost its support about the cannula shaft, whereby the feeler angle(74) reduced and the tripping notch(86) can evade into the transverse pin(87) (Fig.70). This comes about under the trust of the vibrator pin contacting the cap(76). The wire strap or stay(78) being under the tension of the connecting or locking pin (80) penetrates then into the oblique slot(77) and effects the return of the wedge(75) into locking position before passage of the next vibrator pin. Subsequent to the thorough mixing of the contents of the hose in the pump range by way of vibratory motion the tripping pin(28) transcends the steep flank of the opening or passageway(67) in the disk(51), thus cancelling for short period of time the blocking of the spring steel tabs(27) and initiating the injection action. Subsequent to the transcending the steep flank on the wedge profile ledge(56) by the following spring steel tab a sectorial rotation of the large toothed wheel is unblocked under the effect of the compression spring(59) receding, the tripping bar is lowered under spring action, while the mandrel(89) penetrates the cover membrane of the vacuum reservoir cuplet for the reventilation thereof. With respect to the wire strap or stay(78) described above it need be pointed out that, during the lifting of the connecting pin (80) in the terminal phase of the lifting operation of the rammer(69), it is drawn down by frictional connection at the support plates for the

former embodiment relates to the type of construction of the start mechanism for dosing. The schematic diagram shows the upper portion of a vacuum reservoir cuplet comprising an elastically closed window(85) in the rigid cover membrane. According to the position of rotation of the locating screw or pin in the connecting link guide of the drum(71) the rammer(69) with its broadside faces the wall of the cuplet and has sagged past it. The bellows(96) being stationary relative to the drum on account of axis(95) are, in common with and parallel to the pneumatic cylinder(98), attached or connected to a gallows frame or girder(97), the piston of which cylinder constituting at one and the same time the rod of the slide valve(99). The slide valve, being open toward ambient atmosphere, is connected via line(100) and an open nonreturn valve to the bellows. A line(101) connects from the bellow a closed nonreturn valve to a pneumatic cylinder which is connected via line(102) to the -here and now- closed opening of the slide valve. The present position of the slide valve results from the valve rod together with the elastic membrane of the window (85) having been raised, because the negative pressure attracting the membrane became weaker on account of the pressure compensation during the action of raising the skin in the suction cup. If, when inserting a new cuplet, the loading rod or pin is raised, the bellows are compressed by having the air evacuate via line(101) and actuate the pneumatic piston. In this respect, its rod is lowered into the window(85) and the excessive pressure in the pneumatic pump is evacuated via line(102). It is not possible for the bellows to unfold and for the drum to be lowered by rotating and actuating the release or trip for the dosing means(75) until the line(100) is again ventilated by slightly raising the valve rod by means of the window membrane.

In Figure 76 a very schematic presentation of the stages of functioning or operation A - D shows a modification of the mechanism for reventilation the suction cup, as is suitable for devices which cannot -as shown in Figure 75- be reventilated as by destroying the cover membrane of the cuplet. In this example, the sliding valve(99) as a whole is slidable on the rail(103) against the action of compression spring(104). The valve rod(106) of wedge profile to be e.g. actuated by a spring steel tab(27) comprises a separate compression spring(105). The air or ventilation hose(107) is connected to the slide valve in the suction cup chamber; this being most readily done with the suction cup forming part of the injector(Fig.77). A rocking or seesaw-type stop slide or valve(108) is actuated lengthwise of a linke at the valve rod. In stage A the valve rod is on the left, the slide valve is closed and during injection for this condition on the right hand. In stage B the slide valve has been slid to the right, and is still closed, In stage C, the slide valve in the right position is still held by the stop slide or valve, while the valve rod is slid towards the left under the action of its spring, and opened thereby. During this sliding motion of the valve rod, the return motion of the slide valve as a whole is tripped by way of its spring(104) by actuating the stop slide or valve. In stage D the condition of stage A obtain again.

Figure 77 is a longitudinal section of an injector whose dosage pump comprises a collar(107) of cup-type construction and elastic material. This collar is fixely mounted on a rod(110) comprising on its surface a wound grooved recess in the form of a bore for the passage of the drug or preparation. The rod has its lower end housed within the

cannula attachment piece(47) and its upper end in the terminating neck of the pump housing(111). On the top of the rod terminates in a pierced plate or disk(112) for the passage of the drug, which disk expands the hose(44) at this location, thus bridging the section between the drug supply bag constituted as bellows and the terminating neck of the pump housing. The collar(109) faces with its cavity the annular plate(113) attached to the pump housing which extends, furthermore, into a downward conically tapered, elastic and centrally pierced stop or plug(114). Underneath said plug, the rod supports the annular valve plate(115). The pump housing is slidably inserted into the bush(116) of the central axis, about which the component parts for the actuation of the pump are rotably mounted. Said bushes extends to the exterior into the housing cylinder(1). On the bottom thereof the wheel(117) is journaled in a ball bearing, the annular wedge profile ridge or ledge(56) pointing upward and resembling in its functional mode and its configuration the vibrator means of Figures 65-73. Instead of the pin with its terminal ball or sphere enhancing slidability, in this instance three rollers uniformly spaced over the circumference thereof (only one of which rollers is shown in the drawing) are attached via axle pins underneath the external lower rim of the cylinder(119) having bowl-like (double-walled) jacket, the interior wall of which can be slid on the axle bush, yet it cannot be rotated. The compression spring(121) is mounted between the border ring of the twin cylinder and the annular plate(120) attached to the axle bush. Three circumferentially spaced angle plates or elbows extend from the upper border of the twin cylinder through the slots in the axle bush to a location laterally above the plate or disk

(112) in order to engage there the head notches in longitudinal locking slots of the border segment of the locking sleeve(123). The latter transmits the motion of thrust or impact of the rollers(118) from above onto the plate or disk. The annular plate(124) is also fixedly attached to the axle bush to be followed on a ball bearing by a rotatable wheel(125) having a wedge profile ridge or ledge which is directed downwardly. Three rollers face said wheel on the external cylinder(126) slidably mounted in vertical direction towards the adjacent inner wall of the housing cylinder. The annular plate is acted upon by the compression spring(127) braced against the bottom of the housing cylinder(1). The wheel(125) is composed of parts having divergent boundary diameters. The upper part supports externally a rim of locking teeth engaged by the detent or pawl (128) attached to narrow annular disk(30) about which the external face of the annular plate(124) can be revolved. The revolution or rotation of the spiral spring(31) is communicated via the bridge angle(129); said spring being capable of being biased in a manner such that the wheel(125) is not rotated therewith. After reversal of motion the movement of the spiral spring is communicated via the detent or pawl to the wheel(125) and from here via the intermediate cylinder segment(130) connected between wheel(125) and wheel(117) to both of the wedge profile ledges. The pendulum movement of the outer cylinder(126) is transmitted via three U-straps(131) housed in the bores of the axle bush from below to the plate or disk (112). The container cylinder(19) is screwed by means of internal threading onto the mounting plate(4) and supports a guide bushing(132) for the rectangular bar(133). The lower pinion(134) attached thereto engages the correspondingly con-

5 structed toothed rim of the lower part of the
wheel(125), the upper pinion(135) being slidable
on the rectangular bar and engaging the toothed
rim between the projecting disks(136,137) of the
cap or cover(138). Said cover has been provided
with an external threading to be screwed into the
internal threading of the container cylinder(19).
The bore(140) suitable ventilates the inner cham-
ber of the container via the bellows. For the upper
10 pinion to penetrate through the container cylin-
der a slot(141) has been provided therein. Screw
bolts(142) slidable in the slots of the container
lengthwise of a scale permit that the residual
amount of the drug -which corresponds to a corre-
15 sponding height of dosage- is determined before
new bellows are used, and this by preventing by
its stop the cover(138) from being lowered still
further onto the screw bolt.
The illustration in Fig.77 shows on its left the
20 state or condition prior to and on its right the
state during the use of the injector for carrying
out the injection. The support or abutting ring
(15) extends further into a cylinder provided
with a sliding ring(143) to the accomodating cy-
25 linder(144) for the vacuum reservoir cuplet(5).
The ring(145) attached to the accomodating cy-
linder is used for attaching the rubber elastic
collar(147) supporting the suction cup rim. It
comprises, moreover, the guide slots for the re-
30 lease or tripping pins(148), and is used for at-
taching the release mechanism so as to provide
for the suction effect on the skin. Inserted into
the notch or recess(150) of the annular piston
(left side of Fig.77) are, to this purpose, the
35 three locking lamellas(149). By rotating the an-
nular disk(151) in having the angular and bayo-
net-type tripping pins while raising the rim of
the collar(147) the locking lamellas are moved

similar as the lamellas of the central shutter of
 camera to leave the notches of the annular piston
 -which is facilitated on account of the obliquity
 of the notches -so as to have the annular piston
 5 displace itself under the influence of the nega-
 tive pressure between the skin and the vacuum re-
 servoir chamber upwardly up to achieving equali-
 zation of pressure. The boundary membrane(10) is
 stretched in this way. The suction cup rim, being
 10 urged by said from the sides of the resiliency of
 the tripping pins, to start with, against the
 skin itself, is raised to an additional extend
 with the aid of the support ring. In this connec-
 tion, the upper margin of the cylinder(151) ac-
 15 tuates the rocking means(152) against its com-
 pressing springs, the pin(153) being drawn from a
 lower wedge profile ridge or ledge of the lower
 wheel(117) and tripping in this way the rotation
 thereof as well as the dosing action.

20 The mode of operation of the tripping pins(148) is
 schematically illustrated in Figure 79. The con-
 trol ring(154), rotatively journaled by means of
 three head screws(155) at the ring(146) in slots,
 25 is retained by means of the compression springs
 from the points of attachment(145) on the ring in
 the terminal position. As can be seen when in-
 spection said schematic sectional projection the
 bayonet-like bent tripping pins(148) abut with
 30 their oblique side a slot in the control ring.
 When the tripping pins are raised, the control
 ring is initially urged in stage B under tensio-
 ning of the compression springs towards the left.
 When lifting further in stage C the control ring
 35 contacts or abuts the tripping pins such that the
 return action of the compression springs upon the
 tripping pins is not effective. The first phase
 of return comes about due to the elasticity of the
 collar to which they are connected. The locking

lamellas(149) are retained, opposite their functional side of locking, held by the head screws (153). A secondary axle pin(158) connects them rotatable to the control ring(154).

5 Figure 80 illustrates schematically a mechanism for reventilating the suction cup via hose(156). Said hose passes along in slot(157) of the cylinder of the support ring. The associated sliding
10 valve(199) is actuated by a sectorially disposed delay mechanism. with the motion of the manual lever(161), comprising an upwardly directed movement of motion about the dosis indicator disk
15 (159) by means of a resilient tongue or tab rotatable by means of a tubular segment, the valve rod(106) of a slide valve is displaced against its compression spring in such a manner that the opening of ventilation to the hose(156) is closed
20 since the pump cylinder is affixed to the dosis indicator disk. The manual lever must now be lowered in order to pass the steep flank(162) of the connecting link ring below the mounting plate
25 (4). To this purpose, the follower pin(163) withdrawn into the bore(160), thus keeping the return movement of the valve rod locked so long until the manual lever has once again passed the steep flank subsequent to returning to the O-position.
30 The follower pin leaves then, by virtue of the elasticity of the manual lever, said bore, and the compression spring(105) is then capable of opening said slide valve again for reventilating the suction cup. Across the bridge angle(129) there exists a rigid connection between the dosis indicator disk(159) and the pawl(Fig.78). Stage A
35 in Fig.80 designates the condition or state prior to the actuation of the manual lever when the slide valve is open. Stage B designates the state or condition slightly prior to the return of the manual lever into O-position when the slide valve

is closed.

For taking up the operation of an injector according to Fig.78 to 80 the square bar(133) is initially released from the lower pinion(134) and

5 withdrawn from the guide bushing(132). It is now possible to unscrew the mounting plate(4) therefrom. While turning the bellows the connection between the locking sleeve(123) and the elbow

10 (122) can be freed and the pump housing(11) with the cannula attachment piece(47) can be withdrawn upwardly from the axle bush. The cover(138) is

unscrewed downwardly out of the container cylinder. A new pump housing is inserted and, by means of turning the locking sleeve connected adhesive-

15 ly in the manner of a thread to the bellows, the locking action with the elbows is carried out. the upper pinion(135) is slid between the disks

(136,137) of the cover and thereupon onto the square bar subsequent to the container cylinder

20 (19) being screwed again onto the mounting plate. The square bare is reinserted into the guide bush after the container cylinder(19) has been screwed,

prior thereto, to the mounting plate(4). Now, a vacuum reservoir cuplet is taken from the steril

25 packing and inserted under pressure against the bottom cover(165) (Fig.84) into the accomodating cylinder(144), with the guide grooves assuring the correct radial adjustment inasmuch a sthere

is correpondence of their cams(167) in the guide cylinder. Prior to the passage of the locking

30 lamellas the tripping pins(148) must be briefly actuated. Once the locking lamellas have registered, the bottom cover is removed; in any case prior to injection. By turning the manual lever

35 (161) the slide valve is closed for reventilating the suction cup and, subsequent to slightly, pressing the manual lever, said lever is displaced further in keeping with the dosis to be selected

by counting the stopping stages of the pin(153)

along the locking tooth profile ledge or ridge.
The dosis set may be controlled by virtue of the
position of a marking on the dosis indicator disk
with respect to the scale on the container cylinder.
5 If the support ring(15) is set down on the
skin, said ring can be raised only when the direction
of thrust is strictly vertical, otherwise
the accomodating cylinder will jam. By way of
raising the suction cup rim at the collar(147)
10 the tripping pins(148) are effected to be raised
and the locking lamellas to be withdrawn from the
notch of the annular piston(9) which is raised
together with the skin. The lifting action of the
suction cup rim continues until the rocker(152)
15 is actuated and until, hence, injection is initiated.
Said injection is performed at equal surges
or bursts of the fluid in keeping with the
pump motion of the collar(109). When said collar
is urged with its border against sthe annular
20 plate or disk(113) an amount of fluid -by being
sealed thereagainst as well as against the inner
wall of the pump housing- is sealed off under its
border wherefrom a certain amount, measured commensurate
with the segment of motion of the valve
25 rod, is ejected in the direction of the cannula
since the valve (115) has moved away from the lower
plug surface, This point in time is represented
in Fig.77. The rollers are upright, at full
depth, in the depression or recess of their wedge
30 profile ledge; the contra or counter rollers on
the outer cylinder(126) ar upright, at full
height, on the summit of the wedge profile ledge.
The valve plate(115) is carried to distance from
the plug by means of lowering of the rod(110) and
35 the collar(111) approaches with its rims to the
annular plate(113). If the collar has been descended
furthermore, a certain quantity of fluid
will be expelled towards the cannula. But before
the collar lifts off again from the annular

plate, counter-moving, the valve plate has closed again the opening of the plug (in keeping with roller guidance).

5 Figure 80 is a longitudinal section showing an injector with electro-magnetic dosing pump similar to this of Fig.77 which is integrated into the hose, whereby a roll of tightly piled-up sheeting or foil, piled-up with chemicals, assures a gradual release of gas within the container during a control by an relief pressure valve and in that a steady pander-to of drug or medicine; the negative pressure is produced by three boilers which can be be separately opened and must be electrically heated before injection. In Figure 81, besides, the loops(191) at the cannula attachment piece are shown inside of the suction cup with rubber-elastic rim and an inner lip, thereabove the large(168) and small valve piston (169) of the dosing pump with rod(110) and pierced plate(112) inside of the hose are shown. About the plate(112) lay the resilient clamping jaws(171) which are moved by means of the solenoid(170), resilient by spring. Between boiler and solenoid lies the insulating jacket(177) which, here and there, also surrounds the hose (44). The drug container is fastened by the fixing bolt(195) and the fixing screw(194). On its cover(138) the relief pressure valve is mounted and inside the folded bellows(20) with the drug and the roll(182) for gas production. To safe against rotation there are the brackets(190), while the control cylinder(188) with ball bearing is rotatable towards the container by its peg in keeping with the retain-groove(193). Cable connections or terminals(176) lead from the control unit towards the solenoid, towards the resistance wires, towards the start contact(197) and towards the sensor cannula. The resistance wires(178) ex-

10
15
20
25
30
35

tend between insulator rings. The folded bellows
(20) with drug is mounted inside the container
cylinder(19) sealed by tightly screwing the cover
(138) thereto. Between the mounting plate(4) and
the hose the seal(196) is located within the pas-
sageway for that. The bellows contains in its cen-
tral bowl-like depression a rolled-in solid state
package or roll(182) for generating compressed
gas. Tension springs(183) extending obliquely
through the chamber are attached at the locking
pins of the valve flaps(184), which pins being gui-
ded through the bores of the obliquity of the
suction cup. Excentrically exterior to the gasket
ring of the valve flaps, these flaps are respec-
tively reached by an upright rod(185), sealed up-
stream of the control ring(186). They are met by
tripping tabs(187) reaching downward from the
control cylinder(188) and capable of actuating
a rod only respectively after each third lowering
of the control cylinder through the control ring.
It is a prerequisite herefor that the three trip-
ping pins(148) are raised simultaneously within
the suction cup.

For putting the injector in operation the bra-
ckets(190) are bent open and the container cylin-
der together with the pump unit up to the cannula
attachment piece inclusive of an insulating enve-
lope or jacket against thermal effects is with-
drawn from the contactor or control cylinder.

Setscrew or fixing screw(194) is loosened subse-
quent to the cannula being extracted at their
loops(191) from the suction cup. After detachment
from the locking or fixing bolt(195) the bellows,
the mounting plate, the pump housing(111), and
the insulating envelope in their entirety are ex-
changed; the clamping jaws(171) about the disk or
plate(112) are to be closed before the pump unit

is again inserted into the contactor cylinder and locking is carried out. The heating boiler is heated up for a pretermined period of time via the lead to the mains(), giving rise to heated
5 air to pass off, via the valve flaps lifted by the overpressure against the action of the tension springs, into the suction cup chamber or space.

Figure 82 gives a cross section at hights A - B
10 of Fig.81 which shows the distribution of the heating boilers(172) and their cross-walls(174) and the distribution of the heating wires(176).

The projection shoen in Figure 83 shows schemati-
15 cally the rotation of the control cylinder over a cam guided in sliding grooves(189). The schematical rolling-up or projection shows in a range of the control ring merely in raising all cones by the action of spring-suspended tripping pins is it
20 possible to provoke a displacement to the left of the control ring and the effect of the compression spring, whereupon a tripping tab may penetrate into the oblong holes with wedge
obliquity effecting the return of the control
25 ring against the action of its spring. Due to the fact that the three tripping tabs and the nine oblong holes are spaced at the same interval the valve rods being distributed irregularly
beneath the oblong holes, despite of the short
30 turning moments, may be obtained that respectively one valve flap after the other is made to open up. The brackets(190) embedded in the mounting plate unblock the clearance of motion between the
35 drug container or vessel and the remainder of the injector. During the last phase of the lowering of the control cylinder the start contact(197) for the dosing automatic is operated. After the dosing is completed by means of the preprogrammed

pump strokes the reventilation of suction cup events by the opening of the magnetic valve(368) by means of impuls from the control unit. For the next two uses an anewed heating is'nt needed.
5 If the rope(139) is made tightly the electronic alarm beneath the cover is triggered since the drug supply is nearly exhausted.

Figure 84 shows in longitudinal section a vacuum reservoir cuplet of the twin-chamber type which
10 can be used in the injector of Fig.81. One of the three guide groove(166) is illustrated in said Figure, which necessitates even prior to the passage past the locking lamellas that a rotation of
15 the cuplet is effected in a defined angular position. The cams(167) provide for this angular position in the terminal seat of the cuplet.

20 Below the Figure 85 just described there is shown in cross section along line A - B of said Figure the clover-type bulge or bay of the suction cup collar. The tripping pins(148) are arranged in
25 the identication provided therein.

In Figure 86 a vacuum reservoir cuplet of the single chamber type is shown in longitudinal section. It is shown also a locking pin(204) originating from the injector. The function of said
30 pin corresponds to that of a locking lamella. The border membrane(10) is supported by the bottom ring of the support cylinder(205) having in its upper wall a kink towards the interior, constituting a space left for the passage of the thinwalled bulge(206). By means of the annular weld lining(207) the inner margin of the bottom ring of
35 the support cylinder(205), the border membrane (10), and the center of the bottom cover(165) are
40 bonded one with another. The rim of the bottom

cover abuts against the lower margin of the vacuum reservoir cuplet(5) and comprises at least one annular predetermined breaking line to be detached by tearing at a tongue when in the injector abutting said support cylinder on its rim has been taken over by the locking pins(204) of the injector up to triggering the aspiration or suction action relative to the skin. Part of the invention, and as an expansion thereof, is a socket belonging to the one-way cuplet so as to connect the elastic hoselet(209) issuing from the cannula attachment piece. The hoselet terminates in a small ball or sphere onto which negative pressure is transmitted via the shaft of the cannula.

15 The clamp(210) is lifted to check the negative pressure, whereby the ball is drawn inwards. After sucked-in the skin, the clamp can be lifted again to check whether the ball has filled up with blood. During injection the clamp prevents the drug or medicine to stream off into the ball.

Figure 87 shows in a crude schematic view the process of manufacturing of a vacuum reservoir cuplet as in Fig.(19)84. In stage A injection moulding of the cuplet and the annular piston is carried out side by side in conjunction with vertical separation of the mold parts(215,216). In stage B, e.g. the border membrane made by means of three sectorially overlapping revolving conveyors(211,212,213), which membrane and piston are welded by means of an ultrasonic sealing head (214). The conveyor(212) transports the united parts to a press for attaching the bottom cover and places them then under the opening of the vacuum reservoir cuplet. The united parts are conveyed into the evacuating chamber(217) for generating a negative pressure or vacuum by means of a compressor, and are then welded by the ultrasonic head(218) in the area of contact of border membrane and marginal ring(219).

Figure 88 shows a vacuum reservoir cuplet of type illustrated in Fig.65. It is disposed within the sliding sleeve(23) and is in a state for sucking in the skin.

5 Figure 89 shows at a scale of 2 : 1 a projection of the profile ridges or edges(225) on both of the wheels(117,125) in Fig.77. To facilitate comprehension of their mutual functioning they are
10 been approached one to another.

Figure 90 is a schematic illustration of an electric buzzer, the alarm indicating imminent exhaustion of the supply of the carrier(221) there-
15 above, which carrier has a ring about the outlet of both hose shanks from a dosing pump of Fig.65. By means of the vibrations of the buzzer the hoses and the support or carrier disk(40) for the rollers of the dosing pump are also set to vibra-
20 te so that there is no need to incorporate a separate vibrator.

Figure 91 is a longitudinal section view of a modification of the dosing device of Fig.77, showing said device in greater detail. The hose(44)
25 leading downward from the bellows(20) has a expanded configuration at the lower part of the space it includes about the rod(111). Yet another more extensive expansion of the hose replaces the pump housing and is encompassed by the axle bush
30 (116). After the passage of the bore in the plug (114) the rod forms a valve cone(115). A sort of bellows is used as dosing chamber. The hose encompasses at the extended end the carrier or support plate of the cannula attachment or adapter conus
35 (47), which can be regarded as being part of the plug-in or slid-in part.

Figure 93 illustrates the program block diagram for a control unit of an injector as illustrated in Fig.81 and 82 comprising of a Central Processing Unit(CPU),Memory Unit, and Input/Output-Port

5

Figure 93 describes the program flowchart for a control unit of Fig.92.

The functions of the four keys are as follows:

- 10 Key 1 switches, when depressed, the contents of drug supply counter to display.
When depressed again, the safety reserve appears on display. Only after said second depression of this key do keys 2 and 3 perform their functions.
- 15 Key 2 increase the safety reserve.
Key 3 decreases the safety reserve if the supply vessel or container.
- 20 Key 1 turn off the display when depressed a third time.
Key 4 is closed when exchanging the insulin vessel or container.

25 In standby condition the processor enquires as to the state of the four keys and the switch (start contact 197). When the keys are depressed, the processor performs the display and modifies, possibly, the dimension of the safety reserve, as set out above.

30 The switch(197) triggers the injection. Hereafter the stroke counter is fed the value of the prorated dosage (e.g. there are storage modules for 2 to 20 piston strokes per four units insulin each) and, determines the frequency of the dosage pulse and, hence, the amount of fluid of the drug. After the injection has come to an end, a pulse is applied to the magnet for the slide valve(99) for
35 reventilation the suction cup so that the device can again be released from the skin. The supply is up-dated and compared with the safety reserve and the prorated dosage. When the safety reserve

falls short, the alarm is sounded; however, the device continues to be operative. When the pre-set dosage falls short (i.e. the supply of the drug falls below the single dosis to be dispensed), the alarm of alerting device is tripped, and the operation is blocked until a new drug supply reservoir has been introduced while key 4 is closed or stays lock during such time.

10 The Figure 94 shows in a longitudinal section a closing device for the medicine supply container effective until the supply is exhausted. Inside of the housing cylinder(1) a folded bellows as drug supply container(131) is mounted their drug hose (44) being located inside of the drug derivation tube or drain(316) with the supporting ring(601). This leans to the mounting plate(4) inside of which the locking cross-pins(330) clings outside to the springloaded detent bolts(329) with their (outern) tops, while the inner tops are engaged into the annular groove of the drug drain(316). The hose(44) continues downwards into the pump peg (337) with the cannula attachment piece; in the area of the hose rings(415, Fig.45-47) it is surrounded from the axle bush of the device. At the top the folded bellows are fastened inside the inserting cylinder(200) by means of spring biased locking lamellas and can be loosed through side slots. Provided that the befolded bellows are inserted together with the sliding cylinder after being fastened therein into the housing cylinder, the part of hose about the pump peg which is not enveloped contacts to the hose rings. The locking pins(330) engage (as shown in the Figure). If the drug is nearly exhausted the lower rim of the inserting cylinder goes down up to the detent bolts and sink these. The locking pins are now able to (retreat) from the annular groove of the drug

drug drain and the folded bellows can be drawn out again together with the hose by pulling on the rope(139) of the electronic warning device (387).

5 Figure 95 shows a variation of the dosage hydraulic. The separation piston(275) is mounted inside of a multidosage or stop syringe cylinder(272) upwardly to the drug, thereabove an auxiliary fluid is stored which has above a boundary cover
10 piston(801) as a removable part. Thereto, the supporting piston(802) is set up which contains the cylindrical boring with the large(168) and small(169) valve piston which bore is emptied into the space with auxiliary fluid through a bore.
15 A sealing is located between the folded bellows with auxiliary fluid, filled up by sinking the supporting piston under leaking loss, and the valve rod. The valve pistons are operated by the solenoid(413) by means of the valve rod and
20 using the swivel or seesaw-like lever(803). The end of the valve rod engages with two arms shifted in phase into slanting grooves(803) on a disk. The latter is fastened on the threaded bar (905) which bears onto the threaded bush(805).
25 For dosing a dosage unit of auxiliary fluid is pumped from the folded bellows into the space between the separation piston and the supporting piston. In that the supporting piston is supported downwardly the separating piston is displaced and thereby the drug through the cannula. During
30 lifting of the valve rod (the bifucation thereof contacts different slant grooves of the disk at different phases) the disk is rotated and the threaded bar is lowered to this rate which corresponds to the displacement of one dosing unit.
35 Thereby a repective amount of auxiliary fluid runs back into the folded bellows.

Figure 96 brings above a plan view, in the middle
(and below) a longitudinal section along the line
A - B of the plan view and below a longitudinal
section along line C - D of the plan view showing
5 a dosing device which is blown up by pressure of
the solenoid(546).

This solenoid has its place over the short lever
arm, which belongs to two respective plates (545)
folding in a hinge(547). Lever arms and plates do
10 not cross at the end shown below, where the nose
(44) is conducted out towards the cannula. When
the flap opens -as it is shown- the discharge of
the drug is blocked by pinching off between the
short lever arms. At the place at which the drug
15 hose is introduced the plates and the short lever
arms cross like scissors, therefore the afflux
there is unhindered. Between the plates the nose
lies in a loop. When the plates are drawn near by
magnetic effect of the solenoid the hose will be
20 squeezed beginning at the place of afflux the
short lever arms working as springs and then in
the area of the loop between the plates. The leg
of the hose which leads back is conducted out
through the break-through(549) to the surface of
25 the upperst plate as to avoid the stopping of
the discharge. The pressure spring(549) serves
for the reset.

Figure 97 shows the hose(44) positioned in turns
30 onto a spiral ring, which is coiled to a rubber
pyramid. The counter spiral respectively lies
above of the hose turns which are engaged and
it is positioned inside of a cone-like cup.
When it is sunk by the magnetic effect, the both
35 spiral rings respectively keeping greater distance
above as bellow are drowed near at first above
as long as the hose is squeezed above. The hose
is emptied downwards(towards the cannula) in a
peristaltic manner. Whilst the conical cup

lifts up by the compression spring(549) the over-
cup is lifted, first, the rim thereof squeezes
the hose on its lower end.

5 The Figure 98 brings in a schematical longi-
tudinal section a further dosing device as to
drive by a pulsating operation. Piezo-electric
transducers(564) which are driven by electrical
voltage are positioned against a fixed upper-
10 housing and lie on an elastic shroud ring(556).
This contains an expanding part of the hose
through which the hose continues over a lateral
flattening of the shroud ring antecedent the
rigid attachment piece(554) of the derivative
15 tube or drain to a blocking valve. The latter
is freezed by the y the opening of the lid or
cover of the injector as to interrupt the drug
flow even when the piezo-elements are without
voltage. The surface of the lentil-like flatter-
20 ned expanding part of the hose is firmly connec-
ted to a adhering plate(567) which for its part
is fastened at the underside of the pressure
transducer(564). Light guiding fibres lead from
the light source of the left side through the
25 shroud ring and are leveled at wall of the bubble
of hose partial permeable for light. Opposite to
the source of light inside of the shroud ring,
light conducting fibres lead (below of the zone
deformed by pressure) towards the optical sen-
30 sor(561) which is optically connected as well
with the control unit(176) as with the piezo-
electrical switches(562,563). By control of the
switch(562), which is adjustable in height,
piezo-elements get voltage causing its extension
35 and the interruption of the drug flow at the
area of the afflux of the swelling up part of
the hose over its command-transmits. The dosing
impulses now are changed into the stimulation
and the extension of more parts of the pressure
40 transducer, whereby the shroud ring is flattened

and narrowed in the lumen and whereby the swelling
up of the hose will be reduced as long untill the
switch(563) recalls that the pressure transducer
has the adjusted lowest level. When the voltage is
5 changed as to extend the hose this will be filled
up. Inside of the swelling up part of the hose, at
first, a vacuum is generated by the sudden re-
traction of the pressure transducer (because the
fluid dynamics is more inert). When the density
10 is diminished and increased again by filling up
that is answered back by the optical sensor to the
control unit and the next dosing impulse is trans-
ferred to the pressure transducer before the drug
is able to flow unhindered through from the con-
15 tainer to the cannula. By the velocity of the syn-
chronization of the particular parts of the pres-
sure transducer (as a date word in the control
unit) the speed of the outflow (respectively the
distribution of the influence of the pressure over
20 the time curve) may be controlled. By this means
it may be possible to inject also through finer
capillary mains inside of the cannula without the
sudden overpressure causes destruction of tissue.
In such a case of a special narrow outflow channel
25 (as aspired in favour to a pain poor injection)
the delivery of the drug (in retarded cycles) may
be introduced before the measurement of the para-
meters of metabolism is finished. A certain base
rate may be applicated as earlier as the further
30 delivery may be interrupted, possibly, according
to a calculated correction.

The Figure 99 shows crude schematically the con-
nection of a modulating or throttle valve(565)
35 with a control unit, which is developed also as
an inductive fluid-flow measuring device and which
effects the control of the throttle according to
the flow rate which is answered back by the mea-

suring electrodes. Suches measuring devices are described by the literature for Patents multi-
fariously. Par example by G.Geisler, A. Seebode
in DE 33 14 954, K.Walter, F.Hofmann, W.Stelz,
5 Ronald, Venloin DE 24 10 407 or by E.Prinz,
G.Leiser in DE 27 44 845.

Figure 100 shows in a longitudinal section an al-
ternating from one dosing installation into ano-
10 ther using thereby only one motor. The power trans-
ducing bush(605) effects the transport of the
ratched wheel(607) only clockwise by its pawl
(606). The ratched wheel is firmly connected to
the gear shift collar(800) turning free. By the
15 gear shift pinion the gear wheel(859) is driven,
which is fastened on the screwed rod of a multi-
dosing syringe (e.g.), because it is coged to it.
The turning of the ratched wheel(608) is trans-
mitted to the drum(71) with the coulisse slot-
20 -tet link(72) in which the fixing pin(73) effects
the lifting and the lowery by rotation. This shif-
ting on axis works to the gear shift pinion and
causes its position to the gear wheels. To change
the respective dosing program the motor needs,
25 additionally, only an half rotation counter
clockwise effected by pole-changing. In such
a manner a considerable space saving and
weight saving is involved.

30 In the Figure 101 is shown a device for dosage
change in using of solenoids or piezo-transducers
as motor-drive at the top in a lateral view and
below in an plan view. Between the short end of
the swivel lever and the pressure transducer(564)
35 exists an elastic connection(612). The swivel
affixed cap(613) stand over the spring biased
rod(614), whilst the spring lifts the rod when-

ever the pump stroke is activated against the expansion of the hose inside of the dosing chamber. But when a rapid traction impulse works by the pressure transducer, the cap leafs the rod and a spring which is made tense by a pressure lever
5 (616) transmits the cap over the rod of the other dosing mechanism by swivelling.

Figure 102 shows in a longitudinal section a variation of the mechanism to move the cannula magazine vertically before and after the injection referring to the functional stages A and B. The cannula magazine(316), therefore, is easily to shift together with the central holding tube
15 within a bush without seal. The end of the central holding tube broadens to a ring plate(536) which is sealed by an elastic membrane(537) towards the roof of the suction cup. The stage A shows, as the skin is raised into the suction cup by influence of suction and, at the same time, the ring plate
20 (536) is put down so that the skin and the cannula meet. In stage B the skin and the cannula are withdrawn again one from other by the elasticity of the skin and the membrane, after the suction cup has been reventilated.
25

Figure 103 shows in the longitudinal section a variation of an injector in which, instead of a suction cup, a shell(538) is present to insure the cannula. The shell is formed as an ellipse in the one centre of this the central holding tube(324) is arranged capable to be vertically shifted
30 whilst in the other center a central peg(433) bears a ring plate(535) which has a boring for the passage to letting through the central holding tube. Its lower surface being provided with a film(539) adhesiv on both sides.
35

Above in the stage A the central peg is lifted (similar as at the example of Fig.13) with the
40 ring plate and the skin, while the central hol-

ding tube with the cannula was sunk downwards.
Below in the stage B, in the contrary, the central
holding tube has lifted and the central
peg has been sunk so that the skin and the can-
nula are separated. The apply of air pressure
may be avoided in this manner. Between A and B
in a plan view the adhesive film(539) can be
seen with the boring for the passage of the can-
nula which film is encompassed, appropriately, in
a concarde-like manner by the adhesive electrode
ring, and embedded between the two protective
foils(540).

The Figure 104 shows in a longitudinal section the
skin which is elevated into a suction cup whereby po-
larized light is projected through the knob of the
skin onto the detector which is arranged opposite.
The measurement data which are determined in this
manner can be quoted to the correction of the dosage.
It is yet necessary to confirm, whether the sugar
values which are varied more slowly in the tissue
are qualified for the judgment of the actual situa-
tion of metabolism.

The Figure 105 shows at the left side in a lateral
view and on the right in a plan view the basic ex-
periment which was charged to check the modification
of the electrical conductivity onto boundary mem-
branes. A filter paper was stretched to the elec-
trolytically defined silver-chloride-silver plate
(610), laterally sealed, and sepharose - concana-
vallin A was infilled into interstite.
The other side of membrane was rinsed with a so-
lution of common salt of different glucose con-
centration and measured against a calomel elec-
trode(611). It was applied 600 V alternating cur-
rent and significant measuring differences was
affirmed.

Further data:

Amount of conA-sepharose-gel sediment 2,1ml
with about 21mg ConA.
Membrane surface 5,3cm²
Passage through of glucose about 21mg
Measuring effect by about 1mg
Resistance of the arrangement
(ConA-gel/NaCl-glucose/calomel-electrode 10 Ohm
Alteration of resistance after
10 100 mg% glucose solution 250 Ohm
Nominal frequency 10 kHz.
Trisaccharide raffinose as comparison solution
was without effect.

15 With Figure 106 begins an elaboration for opto-
photometrical and biometric measurements. The mi-
nimum blessure of a patient is given respective
to metabolic measurements by the use of diaphany.
20 To explore the conditions during the way of the
light ray a kind of light ledge(900) with single
ends of light transducing fibres(593) is verti-
cally housed to a suction cup(173). Opposite to
this light ledge a detector ledge(901) is embedded
to the wall of the suction cup; to each light
25 point or source(560) relates a belonging detec-
tor(561) with a light transducing fibre to the
measuring instrument(88) and from there is an e-
lectrical conection to the control unit.
To the left the skin is raising and any of the
30 lower dectors announce light absorption.
To the right the skin knob which is produced by
negative pressure has its highest level and many
detectors are shaded. When the control unit checks
that an alteration is never more effected, the
35 light absorption curve may be evaluatedddd(as shown
in the middle. At the time ordinate a spatium Del-
ta, to mark as a wave, relates to the thickness of
the skin. The light absorption has measured tangen-
tially to the skin surface a maximum. A measuring
40 ray may be used for a polarime -

tric obtaining of data relating to the state of metabolism, especially the contents of blood glucose. Therefore the computer of the control unit brings the results of the polarimetric measurement in relation to the thickness of the skin; the measuring ray has to cross the skin twice. The first measuring is completed while the skin is blood-less by the suction effect. About two seconds later the skin is red by hyperemie; the polarimetric measurement is repeated at the same place and the contents of blood glucose is estimated by constituting of the difference value. At the light absorption characteristic a second increase relates to the hyperemie.

Figure 107 shows also in a longitudinal section a measurement arrangement similar to them of Fig 106. Only two light sources(560) and two corresponding detectors(561) touched by the raising skin are demonstrated. The light absorption curve, gained by subsequent measurements, shows a similar course as demonstrated at the Fig.106. P_1 this is the point of the identification of the skin thickness, P_2 relates to the beginn of the hyperemic phase.

At the cross-sectional view of the Figure 108 the possibility is schematically shown to check a blood vessel(902) laying immediately under the skin. Two measuring rays cross near the cannula shaft(8). The position of both light sources and detectors is respectively low with intent to investigate the conditions when the skin is'nt yet raised. The reventilation should be effected by the valve opening over the function of the control unit before the cannula tip has pierced the skin.

Figure 109 is a schematical cross section to demonstrate a similar solution to said of Fig.108. An additonal measuring ray is introduced for

a comparison of the light absorption near to the cannula. As a second way of solution the reflex photometry is indicated, especially as a means to check the nearness of a bigger blood vessel or the contents of blood vessels and their extent of fullness, measured by the comparison between blood emptiness and fullness (e.g. a single light source(560) and detector(561) is represented). Color filters or different wave length of light may be used. An alternating measurement may be applied by a ray source which serves as a detector also(903). A similar mode of operation may take place using a temperature-sensor(904) nearly to the skin knob.

Figure 110 shows in a partial schematical cross section at the scale of 2 : 1 the use of an measuring arrangement tangentially working against and through the skin of the knob. Preferably such device may be housed within the wall of suction cup inside of the inner sealing zone(505)(Fig.112) whereon the skin knob has a defined circumference. Belong to the bended light ledge(900) and detector ledge(901), again, a strong correspondence exists. The single measuring ray, should be equally spaced. The spatium between the single light source or lamp and detector pairs increase in a fixed and known manner(e.g. from $1-d_1$ to $1-d_6$). The light absorption respectively increases but it diminishes at $1-d_6$ because a larger part of the spatium lays into the interstite with lower light absorption. The space between $1-d_1$ and $1-d_5$ marks the thikeness of the skin. This measuring arrangement may be used also to estimate the amount of blood vessels or blood which may be passed by a (e.g. polarized) measuring ray running diagonally through the skin knob(560,561).

As far as each single ray is calculated to pass through skin tissue it is participant to the total measuring result which is gained as an average value. As shown a bigger blood vessel positioned laterally from the passage through of the measuring ray for the glucose destination may falsify considerably so that a correction is inevitable. Therefore at least one second transversally working ray screen(I,II,III...) is usefull positioned with a angle shifting to the proper tangentially measuring arrangement(1,2...) which works at a angle of 90 degrees to the ray for biochemical investigation. If a ray of said proper tangential arrangement is lessened, the control unit activates the ray of the auxilliary measuring arrangement classed with those ray (That means the ray cutting the former together with said diagonal ray for the biochemical investigation, all that three effected as subsequent procedures). The auxilliary tangential ray runs a spatium inside of the skin which depends from the distance of the last inner proper tangential ray and can be calculated. In the case that both the proper and the auxiliar ray are lessened the absorption peak should be brought about by a body(generally a vessel) positioned within the passage through of said diagonal ray and should consider the total measuring result. Of course, at least one further diagonally ray nearly to the investigating ray could be used for a clearing-up of our problem. Generally, a combination of all the here decribed principles may be used.

The Figure 111 is a principle set up of the function even described and combined with the features of the Fig.107. Each electronic expert is therefrom enabled to carry out a more professional

wiring or block diagram. As in all control parts of this invention as well processors as TTL-logic or CMOS technic or similar may be used.

In the first step(1) the ray₁ may be reached by the skin knob and a signal may be obtained as long as the light absorption increases. In this case in the moment while the knob reaches the ray₂ than the reventilation valve should be activated by the control unit. The distance (by a light and detector ledge adjustable for each skin type) between ray₁ and ray₂ is adjusted in such a manner that, normally, the ray₁ has left the tangential position to the skin when the knob reaches the ray₂.

In this case, at step(2) the skin contacts the inner sealing zone and thereby the transversal ray arrangements. The proper arrangement(1,2,3,4,...) deliver its measuring data(3). The control unit figures out the programmed extents and compares them(4). The decrease of absorption caused thereby that the ray₆ leaves the upper solid skin parts in its middle passage, brings the result of the thickness of the skin(5) (as the spatium 6-1=5). If the comparison of the extents relative to the skin passage yields similar values, the beam or ray(560,561) used for investigation is started(6) and its measuring result is composed with the result of prior measurements(7). In such a manner the blood sugar value can be transmitted to display, printer, and dosing device(if any) (8).

If the measuring comparison at step(7) shows irregularities in regard to programmed limits the stage (9) is chosen to activated at least one ray of the auxiliary arrangement or bundle corresponding to the incertain point or peak. If the comparison of ray and reference rays shows not inequalities exceeding the programmed limits the process lead back to the activation of the

resulting organs(8). In the case of a lower light absorption along to the tissue for the auxiliary ray the value of the proper ray should be suppressed(9) and possibly -if the quantity of useful single measuring results is insufficient(10) according to the comparison- replaced by measuring values of the bundle of the auxiliary ray arrangement(11). The uncertain result evokes(12) the warning mechanism(87), the satisfactory result leads back to the activation of the resulting organs(8).

Figure 112 is a longitudinal section of a mechanical driven suction injector at a scale of 2 : 1. The lower part of housing is omitted to save place for reference numbers. The injector consists at its upper part of a container cylinder(19) with an ring-shaped chamber(905) from which a gas pressure control valve(906) leads into the inner space, whilst a nonreturn valve(907) is connected to the interior of the gas producing chamber(908) by the connection hose(909) this hose being turned in windings above to the case of said gas producing chamber. Said case has below a bush(910) with a snap-in spring(911) centrally inserted for the locking of the end cone (912). The tape-measure(913) lies in folds to the left and is pushed through a slot of the lens carrier(921) behind a lens-like window(85). Mentioned may be the sealing ring(914) between cover (138) and the shoulder of the container cylinder (19), the annular groove(915) for the fixation of the three sliding bolts(916) for the bolting of the connection bridge(916) with the pierced plate or disk(112). Mentioned may be also the screwed clamp ring(920) for the cover(138), the central bore(118) for the passage of the dosing rod(110), and the screwing nut(919) for the fastening of the container cylinder (with the drug containing fol-

ded bellows(20)- at the housing cylinder(1) of the lower part of the suction injector. A kind of rotary muffle(922) turns about the housing cylinder(1) fixed on the height; it bears a profile ridge or ledge at its upper and lower side -saw thooth like alternating- wherein the upper and lower rotary pins(923) engages to transform the revolution of said muffle in a pendulum motion of the connection bridge(917) which is guided longitudinally in a slot of the housing cylinder. Three connection bridges equally spaced safeguard a equal power transmission towards the rod(110) of the dosing pump. The pump housing(111) contains casted about the spindle (924) dosing inside of the drug hose(44) oval ring-shaped chamber with pressurized gaz with at least one channel toward the hose in the region of the dosing chamber. On the left the spindle is in the upper position and seals the dosing chamber against afflux; on the contrary on the left half the spindle is lowered sealing the flow through the cannula whereby the dosing chamber is filled up with drug. The pump housing is fastened to the housing cylinder by a spring resilient bolt(925). The motor for the dosing(and the other main functions) is the spiral spring (31) mounted between said rotatable muffle and the toothed wheel(926) and fixed on the housing cylinder(1); with its one the spiral spring is fastened here. The other free end of said spiral spring communicates by the angle bar(927) with the wheel(928) (on the left). On the right the lever(929) is shown excentrically pivoting about the axis(929) which is fastened by the strap(930) on the housing cylinder. The lever may be swivelled by the plug(931) on the wheel(928) which takes along said lever overcoming him at the first step of the clockwise revolution. The lever ends

in a very elastic leaf spring and this clearance is restricted by boundary pegs(932) projecting from said strap to promot the overtaking mechanism. The vertically peg(933) projecting from the lever(929), transmits the motion to the bush(934) with rim ledge engaging in horizontal slot therein. This bush lowered by the guidance pin (935) fixedly fastened onto the housing cylinder; this bush making away in its oblique wall slots (936). Three skin distancing rods(937) insert to the bush(938) and suspend with their heads(939) and a cross-pin in oblong slots of said rim ledge operated by the movement of the bush(934).

To explain the mechanism for reventilation and skin distancing the longitudinal section plane was turned in the right hand side as shown in Figure 113 as line A - B. Continuing on the left, the angle bar(927) communicates its motion via the wheel(928) to the rotary disk(941) after a clearance within an oblong slide(940); the angle rod(942) transmits this motion from said rotary disk(941) to the rotary muffle(922) which operates the dosing pump. Said rotary disk rotates arround the a prolongating bush of the transport disk(943) for the spring resilient blocking bar(944) serving as the dosing obstacle for said angle rod(942). Beneath said transport disk(443) the sector disk(445) is mounted connected with said transport disk for the blocking bar with a clearance resilient by the spring(946). From said sector disk three pins(947) project (equally spaced arround the circumference) through short horizontal slots of the housing cylinder(1) and through oblique slots onto the sliding cylinder (948) lowering them together with its dropping pins(949) which causes the pushing downwards of the vacuum reservoir cuplet(5) through a sealing membrane(950). To operate this drop-

ping mechanism a second over-taking mechanism is provided. It consists by a sliding pin(951) with a large collar for the abuttement of two compression springs at both sides of said collar; said pin(951) being slidable by means of a little cross-pin moved into an oblique guiding slot(952, Fig.113) of said sector disk(945). At the function stage as shown, said sliding pin(951) is moved to the left side and engages in horizontal slot(953) of the inner face of the adjusting ring (954) has limited horizontal groove which permits a clearance of revolutions for said adjusting ring although the motion of the rotary disk(941) is locked by the impact of the angle rod(942) to the blocking bar(944). Regarding to the starting mechanism for dosing this consists of a swivel segment disk(955) with an inner worm shaped link (as a vertical projection shown in II of Fig.114) which is rotatable around its excentrical axis (956). Said segment disk(955) is raised thereby a little by a gradient of its axis screw as to engage with is elastic resilient detent or pawl (957) to the ratched wheel of the lower face of said rotary disk to prevent a premature running back by the effect of the spiral spring(31). The above mentioned link(958) is engaged by the cross pin of the quadrangular bar(959) which is slidable onto a passage through the fixed strap (960) its lower end being sealed fastened to folded bellows(961). Therefrom a channel(962) leads to an opening between the elastic outer collar(147) rim and the inner sealing zone(963) of the suction cup. The downward projecting cam (868) of the adjusting ring works against an elastic tongue of the segment disk(955) as a third over-taking mechanism.

Inside of the accomodation cylinder(144) a vacuum reservoir cuplet(5) is inserted in sealing con-

nection with the cannula attachment piece(47) of the injector. On the left half the stage prior to use is demonstrated, on the right the stage during the injection. The annular piston(9) around the cannula shaft continues centrally in a dish (964) with a cover plate; this faces with a toothed cutting edge ring to the cover membrane(6) made of aluminium which extends between the cuplet rim and said bush. The elastic boundary or boder membrane(10) extends from the cuplet cylinder to the inner part of the annular ring. Behind the latter negative air pressure is preserved in the vacuum storage space(11). To the left the cuplet is shown prior use, to the right half during use. Similar, the dosing pump to the left has its rod raised for stopping of the afflux from the folded bellows. By the pressured gas bolster(925) the hose is pressed inwards against the cavity of the dosing spindle. In such a manner the drug from the dosing chamber flows out through the cannula. To the right said rod with the dosing spindle is lowered piercing the membrane inside of the cannula funnel with its sharpened point. The spindle prevents the drug to flow against the cannula but permits the afflux to the dosing chamber which is blown up by the over-pressure from the folded bellows. To prepare such a suction injector for use, a folded bellows with the gas producing chamber (908) and the pump housing(111) as a plug-in unit in the whole is pushed into the container cylinder(19). A cap of the connection hose(909), is removed after the hose was squeezed and the conical end is stuck into the funnel of the non-return valve(907). The tape-measure(913) is introduced onto the slot of the lens carrier(921), than the latter is deposed with its holding arm into the niches of the container cylinder wall.

The hose squeezing is unblocked and the cover (138) tightly fastened by its screwed clamp ring (920). The folded bellows may be adhesive sealed with its under face toward the bottom plate of the container cylinder. The gas producing chemicals may be brought together by shaking, after the pump cylinder(1) and the container cylinder is subsequent screwed on. Prior, the sliding bolts must be closed around the pierced plate or disk(112).

The Figure 113 shows a simplified cross section along to the line A - B of the Fig.112 showing the spring resilient blocking bar(944) which may be pulled and rotated clockwise keeping with a dosage scale at the surface case(965). The edge-shaped end of said quadrangular bar engages with the fixedly toothed wheel(926) one tooth space corresponding to one dosage step. Beneath the transport disk(943) in its oblong slot the resilient spring(946) for the backwards movement of the sector disk is shown. The latter is moved by a cam(968) on the adjusting ring(954). The effect of the oblique guiding slot(952) of the segment disk against the cam or cross-pin of the pin(951) is demonstrated with dashed lines, this slot lies lower. With dashed lines also the oblong slot of the rotary disk is shown -the corresponding slot of the transport disk is traced with full line.

The Figure 113 is a cross section along to the line C - D of Figure 112. It shows the position of the suction switch with its folded bellows (561) and especially the recesses(966) for the plugging-in of light ledges whose are joint together and with the control unit with measuring (88) and warning(87) function by an elastic belt (967).

To use a suction injector as described in Fig.112 to Fig.114 the blocking bar(944) may be pulled

and rotated by its transport disk along the dosage scale for preparing a single dosage. Then the adjusting ring may be rotated clockwise against the pre-tightened spiral spring(23). During the clearance by the oblong slot(940) the lever(929) is swivelled while the distancing rods(938) being raised. At the same time the cam(968) moves the segment disk(955) which is screwed upwards as to engage with its pawl(957) with the ratched wheel of the rotary disk(941). From this instant, a backward movement of the wheel(128) not takes place again as to facilitate the manual operation. A further revolution of the adjusting ring transmits its motion to the rotary disk(941) by means of the angle bar 957 at the end of the oblong slot(940). When said angle bar pushes against the blocking bar(944) there is a hole within the outer face of the fixedly bush of the toothed wheel(926) whereinto the pin(951) evades by the effect of the pre-tightened spring at its left side. The end of said pin(951) is withdrawn from the slot(953) at the same time as to freeze the motion of the adjusting ring which effects against the weak spring(946). The rotation of the sector disk(945) causes the lowering of the pins(949) against the upper rim of a used vacuum reservoir cuplet(5), which can be grasped, removed, and replaced by a new cuplet.

Subsequent to having pressed the bush(964) against the skin, the aluminium or cover membrane (6) breaks near at said bush, air enters and drives the border membran which may be thereby stretched into the suction cup. By pulling of said border membran and pushing by manual pressure the cutting edge of the plate of

said bush cuts the cover membrane in a ring-shaped manner along the rim of the cuplet. An adhe-

sive sealing plate(969) may support the descendent skin while the tip of the cannula pierces first said sealing plate and then the skin. The negative pressure sucks the air from the suction switch as to pull the bar(959) with the diminution of the folded bellows(961). Under the effect of a separate spring the motion of the segment disk(955) for short distance because the profile of the link(958,II Fig.114) resists to the cross-pin of said bar. After the skin is sealed around the inner (and seal zone(963) of the suction cup, the outer space towards the outer elastic suction cup rim or collar(143) is reventilated and thereby the folded bellows of the suction switch. The latter extends by its own elasticity and the bar(559) lets the motion of the segment disk free thereby. At this further motion the segment disk descends into its axis thread and the pawl retracts from the ratched wheel of the wheel(928) which is driven by the spiral spring(33). The counter clockwise revolution of the angle bar(927) effects a motion of the rotary muffle(922) which is transferred over the connection bridges(917) to the pierced plate or disk(112) and thereby to the pump rod(110). After the preprogrammed pump cycles are finished and the dosis is thereby injected under the skin, the motion of the rotary disk is blocked by a peg projecting from the surface case at the zero point of the scale(not shown). The slot(953) permits the wheel(928) to rotate a further distance. Therby the lever(929) is taken back and the distanting rods(937) are lowered against the skin. The latter is withdrawn from the inner zone of the suction cup -reventilated by this manner- and the skin is distanced from the cannula tip to avoid cutting wounds.

The contents of the drug container can be always proofed by means of the tape-measure pulled past to the lens-like window(85). When the supply is exhausted during the injection, the end cone (112) is arrested by the spring(911). Now, the stroke of the dosing rod(110) is blocked and therewith the other provided automatical functions. The patient is compelled to pull off the injector from the skin and to repeat the injection with the new programmed resting dosis.

Figure 115 shows in a schematical longitudinal section at a scale of 1 : 5 a suction injector consisting of two parts connected by a spring 969). The lower part, mainly, consisting of the suction, in this example joint by a channel with a surrounding boiler(972) with resistance heating wires(178). During the electrically performed heating the hot and thinned air escapes by the valve flaps(184) and enters again through those when the three tripping tabs are activated(similar as described in Fig.82). The drug hose towards the cannula is rolled up and can be prolonged when the upper handle piece is lowered against the suction cup. The plugs(970) enters thereby into the niches(974) of the handle piece of the suction cup piece safeguarding a rigid and inflexible connection between both parts. After the vacuum effect is started the manual pressure against the skin should be released and this, finally, may also event by fatigue, as an essential condition of an unhindered gliding of the skin into the suction cup. The pressure(spring(971) promotes this keeping of distance which allows even manual angle movements without danger to break off the vacuum within the suction cup.

Figure 116 shows in a longitudinal section a corresponding solution of this problem for a device as described in Fig. 112 to 114. A over beaker supported by the spring(971) swings about a suction injector typed as in Fig. 112 serving as a buffer for movements away from the injector axis. During starting the vacuum effect a firmly connection between both parts is ensured by the engagement of the cover plug(970) into the central niche(974) of the injector cover. Around the injector housing a collar(973) supporting said spring(969) is slidable mounted to facilitate the removal of the upper part of injector for the access to the lower part.

Figure 117 shows a special cannula having a hoslet inside, which is bent back with its free end while the other end is tightly connected with the attachment piece(47). When fluid is filled into said hoslet, its free end is driven out of the shaft(379). If that is done after the cannula tip has pierced the skin, the fluid can be injected in lower parties of the subcutaneous tissue. An other advantage is given with the possibility to lengthen the spatium with skin contact if a sensor coating of this hoslet is provided. The device is shown in a longitudinal section at a scale of 5 : 1.

Figure 118 shows a simmlar cannula as this of Fig. 117. The only difference is that the hoslet clapped inside with its free end which can be unfolded by pressure from the fluid. To the left the stage is demonstrated with the cannula prior to use, to the right the stage during the use.

Figure 119 shows a cannula similar to said of Fig. 107 and 108. But the hoslet is made of high

elastic rubber-like material with thinning towards the end, initially yet closed by a thin membrane of the wall (to the left). When fluid is applied with pressure the hoslet is extended leaving the shaft with its end which bursts.

Figure 120 is further improvement of a type of dosage hydraulic as shown in Fig. 95. A longitudinal section is given. The device consists of a cylinder (272) of a step syringe as supply container including a separation piston (275) with a central bore. This bore is closed by a little valve piston (168) which is driven by means of a rod connected to a solenoid (413). The latter is incorporated in a supporting piston (802) fixedly fastened to said separating piston. Said valve rod ends with a conical calibre jump abutting against cross-pins (752). If the wires (975) leads current, a pump stroke is caused by the solenoid.

By lowering of the valve rod its conical portion urges the cross-pins against the cylinder wall. By that the motion of the both large pistons is locked. In further phase of lowering of the rod its cross-beam (976) strikes the guiding tube (977) and, finally, effects a determined stroke of the little valve piston. Such is caused a direct displacement of the drug towards the cannula. To prevent a back-flow during the return-motion of the little valve piston a nonreturn valve is necessary. Such may be substituted by a cannula with prolonged hoslet as described in Fig. 117-119, the collapse of this preventing such back-flow.

Figure 121 shows in a longitudinal section a device similar to said of Fig. 120. The separation piston is surrounded at its lower end by a hose ring (415) which may be filled with auxiliary

fluid from a dosing pump(168) It is driven by the solenoid(413) in pump-cycles. After the first pump phase the blowed up hose ring lockes the motion of the separation piston(275). A further determined swelling up of said hose ring effects the displacement of the drug from the cylinder (272) of the step syringe.

Figure 122 shows in a longitudinal section a part of a suction injector with a vacuum reservoir cuplet(5) inside of the accomodating or housing cylinder(1). Between the annular piston(7) and the cuplet cylinder extends the roll membrane(976). Before the annular piston lies the border membrane(10) which can be stretched. The annular piston is held (against the suction from the cuplet chamber) by the abutting disk(977) with its three outer projections(978). These projections abut on the inner projections(979) of the border ring welded to the cuplet cylinder. Below, in a schematical cross section, the three projection pairs are shown inside the housing cylinder(1). To the left(I) the obliquity of the abutting surfaces of the projections are shown necessary for a rotation caused by the triggering lever(980). This may be mounted inside of a collar membrane(981) which contiues the collar of the suction rim. A rotation of said levers, equally spaced about the housing cylinder, causes with its angle(982) the revolution of the abutting disk(977) arround the central bush(964). Thereby, the projections disengage and the annular piston(7) is lifted together with the skin.

While the invention has been illustrated and described as embodied in an injecting device, it is not intended to be limit to the details shown since various modifications and structural, changes may be made without departing in any way from the spirit of the present invention.

Examples for an automatically dosis adjustment
in the case of tissue glucose level differing from the expected value:

retard insulin values	nominal values	actual values	correction factor	corrected values	dosis correction	applied insulin	doses retard insulin
glucose tolerance							
					calculation inclusive		
+not having eaten nominal value					patient 1	patient 1	patient 2
					unmod.Ins.		
					patient 2		
					retard ins.		
					value		
80E	90-120 mg/p.c.	180mg/p.c.	10	10x1x8		+80E	-20E=60E
	100mg/p.c.	50 mg/p.c.	4		4x1x20		
60E	90-120 mg/p.c.	180 mg/p.c.	7	7x1x8		+56E	-60E=0
	100 mg/p.c.	50 mg/p.c.	12		12x1x5		
40E	90-120 mg/p.c.	180 mg/p.c.	5	5x1x8		+40E	-20E=20E
	100 mg/p.c.	50 mg/p.c.	4		4x1x5		
20E	90-120 mg/p.c.	180 mg/p.c.	3	3x1x8		+24E	-20E=40E
	100 mg/p.c.	50 mg/p.c.	12		2x1x5		
16E	90-120 mg/p.c.	180 mg/p.c.	1	1x2x4		+8E	-20E=0
	100 mg/p.c.	50 mg/p.c.	2		2x1x5		

TABLE 1

0000 000

C l a i m s :

What I claim is:

5

1. A device for the injection of fluids under
the skin,
thereby characterized,
10 that at least at the nearness of the cannula
a sensor is arranged, which allows to measure
alterations of metabolism in the body and to pre-
pare the measurements for the information.

15

2. A device as claimed in Claim 1 ,
thereby characterized,
that the cannula itself is developed as sensor
to prepare alterations of the metabolism in
20 the body for the information.

3. A device according to claim 1 and 2,
wherein the cannula shaft, behind the ground sur-
face and sustaining ring closure thereof, is ope-
ned duct-like, the lacking wall being replaced by
5 an inlay of synthetic material and endowed with
sensor properties.

4. A device according to claim 1, 2 and 3,
wherein special insulating zones with respect to
10 conductivity are provided between cannula shaft
and the duct-like opened shaft.

5. A device according to claim 1 and 2,
wherein a smal hose having sensor properties is
15 attached on at least one portion of its surface,
and this in tight connection with the drug fee-
ding channel within the duct-like opened shaft.

6. A device according to claim 1 and 2,
wherein at least one thin tablet is mounted in
20 the bore of a cannula and endowed with sensor
properties.

7. A device according to claim 1 and 2,
25 wherein within the cannula shaft there is provi-
ded a cavity at at least the top portion into
which the sensor coating is placed.

8. A device according to claim 1 and 2,
30 wherein on the link to the cannula there is pro-
vided both an inner contact with the conductor
within the cone of the overplugged cannula and
an outer contact, which latter contact reaching
spring tongue-like over the cannula adapter as
35 sliding contact.

9. A device according to claim 1 and 2,
wherein a cannula is provided on that end, which
is opposite of the cannula shaft, with an ope-
ning for accomodating the shaft of another iden-

tical cannula, the feed of the drug or preparation taking place from the side.

5 10. A device according to claim 1 or 2 and 9, wherein the cannulas are stacked one above another in a tube-shaped container, with accommodating one cannula shaft of an adjacent identical cannula in the shaft bearing body and supplying the drug laterally.

10 11. A device according to claim 1 or 2 and 9, wherein the cannula comprises a cannula body subdivided into an upper and lower chamber, the upper chamber of which functioning as chamber for
15 accomodating the shaft of an identical cannula.

12. A device according to claim 1 or 2 and 9, wherein the cannula body is laterally provided with an annular groove.

20 13. A device according to claim 1 or 2 and 9, wherein the upper cannula chamber is closed by a septum having a central hole.

25 14. A device according to claim 1 or 2 and 9, wherein the cannula between upper and lower chamber comprises an annular notching functioning as hinge joint.

30 15. A device according to claim 1 or 2 and 9, wherein the cannula are stored within a hose.

35 16. A device according to claim 1 or 2 and 15, wherein an operational cycle sets in above a cannula exchange mechanism in the suction cup cover, in which cycle used cannula will take up, in the container hose, the space of unused cannulas.

17. A device according to claim 1 or 2 and 16,
wherein at least one seal is slidable mounted
within the reservoir or container tube so as to
separate used cannulas for unused one.

5
18. A device according to claim 1 or 2 and 17,
wherein an elastically compressable body endowed
with springiness is located between two sealing
bodies in the reservoir or container hose, which
10 body operates so as to store a momentum of move-
ment for the cannulas.

19. A device according to claim 1 or 2 and 17,
wherein a sealing body has been provided in the
15 cannula magazine behind the last unused cannula,
the body of the cannula being itself suited to
function as sealing body and the end of the can-
nula magazine having pressure gas introduced there-
into so as to push the cannula forward.

20
20. A device according to claim 1 or 2 and 9,
wherein a thread-like interconnection exists bet-
ween the cannula bodies, which interconnection
permits said cannula to be transported by way
25 of pulling or draft action.

21. A device according to claim 1 or 2 and 9,
wherein an air-tight releasable connection exists
between each one upper and lower chambers of
30 different cannulas.

22. A device according to claim 1 or 2 and 9,
wherein cannulas and cannula magazine deviate in
cross section from the circular shape.

35
23. A device according to claim 1 or 2 and 22,
wherein the drug or preparation inlet opening in-
to the cannula is located on a flattened portion
of the cannula body.

24. A device according to claim 1 or 2 and 9,
wherein the cannula body comprises in its wall a
conduit being adjustable in height and extending
parallel to the cannula shaft in order to save or
5 economize on a lower chamber for introducing the
cannula shaft of the adjacent cannula in the can-
nula body.

25. A device according to claim 1 or 2 and 15,
10 wherein both ends of the hose for cannula storage
are united by means of banderole.

26. A device according to claim 1 or 2 and 25,
wherein the cannulas, before connecting the hose
15 storing them to the injection device, are preven-
ted by at least one pin or thread transverse to
the direction of conveyance of the cannula from
filling out the hose.

27. A device according to claim 1 or 2 and 9,
20 wherein a leaf spring is provided at the end of
the central retaining tube for the cannulas,
which spring dislocates the cannula passage while
unblocking it via a bore when a switching or
25 tripping mechanism acts thereupon.

28. A device according to claim 1 or 2 and 27,
wherein the leaf spring at the end of the central
retaining tube is actuated by a trip pin in con-
30 nection with the supporting arm or bracket for
magazine hose.

29. A device according to claim 1 or 2 and 9,
wherein an accomodating tube is provided for ta-
35 king up said used cannulas, a resilient sleeve
being slidable on said tube and comprising
spring bending for the cannula transport in
one direction.

30. A device according to claim 1 or 2,
wherein a loop(192) is attached on a connecting
cone(224) extending in the cannula shaft, which
loop permits the cannula to be removed from the
5 suction cup subsequent to it having been utilized therein.

31. A device according to claim 1 and 2,
wherein a bracket is provided for a conductive
10 overpluggable bracket for attachment of a cannula towards the shaft of the cannula, across which bracket a junction of path to a measuring device is provided.

15 32. A device according to claim 1, 2 and 31,
wherein the measuring device is supported on an elastic arm band whereby a contacting pad having electrically conductive properties with respect to the skin is retained.

20 33. A device according to claim 1 and 2,
whereby the cannula is connected to a drug feeding hose of an infusions pump associated with a measuring device.

25 34. A device according to claim 1, 2 and 33,
wherein the cable to the measuring device extends, by sections, within the outputting tube functioning also as insulation.

30 35. A device according to claim 1 or 2,
wherein an electronic storage unit is provided whereby measured data are stored at regular intervals to be later displayed via a reader outside of the device.
35

36. A device according to claim 1 or 2,
wherein a plate having skin-adhesive properties
is provided within the injection device, which
plate provides spacing for permitting a cannula
5 to pass when said plate is moved upward by a
mechanism and the skin to be raised.

37. A device according to claim 1 or 2 and 36,
wherein said plate is disposed within an envelope
10 safeguarding that the surrounding skin is kept at
adistance.

38. A device according to claim 1 or 2 and 37,
wherein a mechanism is provided to move the
15 mounting support of the cannula towards the skin.

39. A device according to claim 1 or 2 and 36,
wherein two double-sided adhesive sheetings or
foils in cocard- or rosette-type arrangement are
20 provided between two protective sheetings, the
interior of which being destined to be attached
to the plate and the ring-type exterior to be
attached to the rim of the envelope or shell.

40. A device according to claim 1 or 2,
wherein said device is utilized in connection
with a suction injector device operated to have
the skin raised by negative pressure within the
suction cup into the cannula.

41. A device according to claim 1 and 2,
wherein the cannula is arranged inside a reser-
voir cup let preserving said negative pressure
and has a lead issuing from its shaft capable of
35 being connected via a jack or connector on the
reservoir cuplet to a cable leading to the mea-
suring device.

42. A device according to claim 1 or 2 and 41,
wherein a valve pin inside of a tubular guide or
conductor is slidably mounted in a negative pres-
sure preserving reservoir cuplet with suction
5 cup, the upper tube being closed by rectifying co-
covering sheeting or foil, whereas the valve pin
surmounts the suction cup rim prior to use and
comprises a type of leaf spring abutting the
suction cup rim and being appropriately con-
10 structed so as to move the pin upward more ab-
ruptly.

43. A device according to claim 1 or 2 and 41,
wherein the rim opposite of a cover membran(6)
15 and part of a vacuum preserving cylinder(5) is en-
larged to form a border ring(223).

44. A device according to claim 1 or 2,
wherein a surface support is provided in the vi-
20 cinity of the suction cup as prophylactic measure
to prevent the device from tipping during the
injection operation.

45. A device according to claim 1 or 2 and 40,
25 wherein the mounting support for the cannula sup-
ports an annular plate at its end inside of the
suction cup, which annular plate is connected to
a membrane sealed against the suction cup roof
or dome in order to descend upon the action of
30 suction or negative pressure inside of the suc-
tion cup together with the cannula and to return
by spring action subsequent to reventing the
suction cup again into the more elevated initial
position.

35 46. A device according to claim 1 or 2 and 40,
wherein the suction cup is slidable mounted,
against the action of springs inside of a tra-
versing slide or guide bush in manner so as to

be retained by a snap-in device for a period of time until the reventilation of the suction cup has been effected.

5 47. A device according to claim 1 or 2 and 40,
wherein a control pin, subsequent to injection
and prior to the termination of re ventilation
of the suction cup, is moved inside of said suc-
tion cup towards the skin so as to keep ist at
10 a distance form the zone of the cannula tip.

15 48. A device according to claim 1 or 2 and 40,
wherein a valve, during the action of rendering
the suction cup space or chamber smaler by way
of approach and during penetration of the skin,
prevents air compression in said suction cup.

20 49. A device according to claim 1 or 2 and 40,
wherein at least a sand or dust filter is provi-
ded inbetween the suction cup chamber or space
and that space or chamber in which the suction
cup piston is didsplaced in a cylinder for gene-
rating negative pressure or vacuum.

25 50. A device according to claim 1 or 2 and 40,
wherein the spring for the suction cup is placed
under tension intermediary of a Bowden wire in
actuating the supporting arm or bracket for the
suction cup cover.

30 51. A device according to claim 1 or 2 and 50,
wherein the lever arm connected to the hinge of
the supporting arm for the actuation of said Bow-
den wires to effect movement of the piston have
an angular position such that an excessive stroke
35 is caused so that the action of the spring re-
tains the supporting arm in a terminal position.

52. A device according to claim 1 or 2 and 50,
wherein a telescopic rail is mounted at the sup-
porting arm for the tube with cannulas in order
to facilitate actuation thereof.

5

53. A device according to claim 1 or 2 and 40,
wherein said piston inside of a suction pump,
the suction piston of which is moved by spring,
is additionally prevented in effecting initial
10 movement during its snap-in position by way of
friction augmenting means.

15

54. A device according to claim 1 or 2 and 53,
wherein said piston inside of a suction pump,
the suction piston of which is by a spring, is
additionally prevented in effecting initial mo-
vement during its snap-in position by way of
magnetically active means.

20

55. A device according to claim 1 or 2 and 40,
wherein the suction piston is retained, by means
of a rod, in its position prior to the genera-
tion of negative pressure, sealed inside of a
type of bellows with respect thereto and with
25 respect to its bearing bore.

25

56. A device according to claim 1 or 2 and 40,
wherein an opening for reventilation, communica-
ting with an electromagnetic valve, is provided
inside the space in which negative pressure is
30 maintained during injection operation.

30

57. A device according to claim 1 or 2 and 56,
wherein the electromagnetic valve is comprised
of an elastic membrane having a disk made of
35 magnetizable material in the center, which disk

is urged by an electromagnet depending on its direction of current flow in its winding towards a venting opening, in closing it or being attracted by the magnet to the opening.

5

58. A device according to claim 1 or 2 and 46, wherein a valve is provided between suction cup chamber and suction cylinder space, which valve is opened, when the suction piston returns in its position, prior to suction generation for reventilating said suction cup.

10

59. A device according to claim 1 and 2, wherein a control unit is provided which evaluates the signals detected by the sensor cannula, transmitting them to a printer and a display unit, and transmitting instructions to at least one dosing device.

15

60. A device according to claim 1 or 2, wherein drug injection is carried out automatically via a preprogrammable dosing device, and wherein the dosis to be dispensed may be set, via a computing and control unit, into relationship to the detected or determined measured quantities.

20

25

61. A device according to claim 1, 2 and 40, wherein a metal ring on the suction cup rim functions as comparison electrode for the measuring unit.

30

62. A device according to claim 1, 2 and 40, wherein a ring-type adhesive electrode is provided for the attachment of the suction cup rim.

35

63. A device according to claim 1 or 2 and 60, wherein the control or operative elements for

programming the dosage of the drug or preparation in association with temporal length are for functional clarity combined into blocks.

5 64. A device according to claim 1 or 2 and 59, wherein the control or operative elements are provided on the inner rim thereof with regularly spaced notches or recesses causing reactions to contacts for programming.

10 65. A device according to claim 1 or 2 and 64, wherein control or operative rings are mounted in series and slidable about the housing cylinder, which rings arranged in row and having an
15 inside surface of wave-like configuration, actuate two sequenced contacts on a switch panel, when rotation about respectively one snap-type switching position, following one another and in such manner that the matrix for the switching
20 position is determined from the sequence of the actuation.

25 66. A device according to claim 1 or 2 and 65, wherein issuing from at least one control or contactor ring is, hook-like, a type of control or operative pin which may encounter a projection or a similar control or operative pin of another control or contactor ring, without allowing it to be moved therepast.

30 67. A device according to claim 1 or 2 and 65, wherein the numbers on the outer ring of the control or contactor rings are raised and may be placed in rows for programming such that the program data can be printed out via a reproducing system.
35

68. A device according to claim 1 or 2 and 65,
wherein the control or contactor rings have ribs
provided on their sides facing one another so
as to facilitate locking of said rotation motion
by an increase of friction.

69. A device according to claim 1 or 2 and 68,
wherein a locking device to be actuated by means
of a key retains said control or contactor rings
in their program position.

70. A device according to claim 1 or 2 and 60,
wherein at least one counter unit is provided
wherefor the data store, relative to the amount
of drug dispensed by the associated dosing de-
vice -which data being processed in such a manner
that subsequent to a predetermined amount of the
drug-, an alert or alarm is actuated and, when
the supley is nearly exhausted, a printer is
rendered operational.

71. A device according to claim 1 or 2 and 60,
wherein a counter unit is provided which de-
tects via at least one counting contact the con-
sumption of cannulas of a magazine and which ac-
tuates via data processing subsequent to a pre-
vious determined number of cannulas an alert or
alarm and, when the magazine is almost empty,
a printer is rendered operational.

72. A device according to claim 1 or 2 and 59,
wherein the contact in the central supporting
tube for the cannulas, which contact functions
to transmit data between the cannula shaft and
the measuring unit and, functions also, simul-
taneously as contactor switch for the counter
unit with respect to the consumption of said
cannulas.

73. A device according to claim 1 or 2 and 59,
wherein a contactor switch in the operative range
of the contactor or control pin for the exchange
of cannulas transmits the data of count relative
5 to the consumption of cannulas to the counter
unit.

74. A device according to claim 1 or 2 and 59,
wherein the function of printer is delayed for
10 a predetermined period of time to the receipt of
data from the measuring unit with continued
advance of the recording or logging band.

75. A device according to claim 1 or 2 and 65,
15 wherein the control or contactor rings have for
rotation, inside of the respective spring-guarded
snap-in position for determining a stage of ad-
justment, some back-springing play in order to
interrogate by means of actuating a switch the
20 actual effective index value from the electronic
store on an associated reader.

76. A device according to claim 1 or 2 and 59,
wherein instruction is given by the indicating
25 means for refilling the almost exhausted drug
supply from a new supply reservoir, the drug out-
putting tubes being, in keeping with the provi-
sions of construction, interconnected and pum-
ping back, via the dosing device, the difference
30 amount required for replenishing an expected pro-
grammed dosis into the nearly empty supply con-
tainer or reservoir.

77. A device according to claim 1 or 2,
35 wherein the drug supply container or reservoir
is first unblocked electromagnetically for out-
putting from the device when the drug supply is
emptied to a predetermined extent.

78. A device according to claim 1 or 2,
wherein on instruction of the patient a multiple
of an approximate daily dosis is determined via
a control unit to be transfused via the dosing
5 device into the nearly emptied supply reservoir,
and pumped back.

79. A device according to claim 1 or 2 and 60,
wherein at least one timing programming unit is
10 provided forwarding at least one deadline each in
comparison with a clock unit to an alarm or
ringing unit and narrowing down, beyond the
period of time for the call-up or recall off
specific amounts of the drug -variable between
15 temporal limits, which are variable yet deter-
minable.

80. A device according to claim 1 or 2,
wherein at least one programming unit is provi-
20 ded determining deviations -being variable yet
determinable for the individual case- of mea-
sured chemical parameters downward or upward
wherein no adaption of dosing from a normal
dosage takes place.

81. A device according to claim 1 or 2,
wherein a normal dosis for specific periods of
time can be determined within a programming unit
for at least one type of drug corresponding
30 tp the association to one dosing device and which
permits also a correction thereof according
to at least one stepped elective correcting
factor in connection with the deviations of the
determined chemical parameters from the stan-
35 dard value assessed as desirable..

82. A device according to claim 1 or 2 and 81,
wherein at least one programming unit for a

special dosing program within variable dosis
limits assessable for the individual case
within specifiabile time limits can be selecti-
vely addressed in the case of the variable yet
5 -for the individual case- assessable paramete-
ters being transcended.

83. A device according to claim 1 or 2,
wherein the ringing system comprises an acoustic
10 and optical signal transmitter and also a vibra-
tor as such transmitter, which system can be
arbitrarily blocked by the patient, the swit-
ching on and off being capable to be printed
out by a printer.

15 84. A device according to claim 1 or 2 and 60,
wherein wherein switching and delaying means are
provided allowing the patient to delay injection
until the patient has had enough time to decide,
20 or to break such injection off, the printer such
data out also.

85. A device according to claim 1 or 2,
wherein a programming automatism lockable as to
25 its function is provided whereby a preset dosing
program can be modified if their are a number of
distictly diverging measured values with correc-
tions which are an indication of an erroneous
setting of dosis.

30 86. A device according to claim 1 or 2 and 85,
wherein the depot insulin dosage for the injec-
tion deadline with respect to measured quanti-
ties assessed therebefore in point of time,
35 with multiple additions of immediately working
or unmodified insulin in keeping with the pre-
set dosage, can be raised in stages; whereas,
by falling below the measured quantity, a reduc-

tion of the depot insulin is noted down as future dosage.

5 87. A device according to claim 1 or 2 and 85,
wherein a programming automatism becomes effective, for correcting the dosis setting for unmodified insulin with the cooperation of the patient, which automatism effects, at raised or lowered control data subsequent to a regular
10 injection deadline, a stepwise adaption of the unmodified insulin dosis in the dosing program.

15 88. A device according to claim 1 or 2 and 85,
wherein a program automatism lockable as to its function becomes effective for correcting the setting of the correction factor for unmodified insulin with the cooperation of the patient, which automatism modifies, in accordance with the raised or lowered measured data during the
20 measurement control and subsequent to a deadline to be scheduled by the patient at specified least intervals for injection and prior to a dispensation of unmodified insulin, and to effect such modification in steps or stages.

25 89.-91. are missing inadvertently at PCT.

30 92. A device according to claim 1 or 2,
wherein the piston of the step syringe is a type of wax envelope, the frictional abrasion of which being attuned or matched to the conic restriction of the cylinder.

35 93. A device according to claim 1 or 2,
wherein a pin, as dosing means, is located inside of the tube having rigid walls for outputting the drug, which tube has an inlet channel

to said rigid-walled output, and wherein tubular rings are placed between said drug conveying tube and a fixed envelop which is filled, in part sequentially, by an electrically operated pump with an auxiliary fluid in a manner such the flow of the drug is partially interrupted and the fluid is ousted or displaced in specified amounts in one direction by peristaltic movement.

10 94. A device according to claim 1 or 2 and 93, wherein the pin is made of elastic material.

15 95. A device according to claim 1 or 2, wherein a tubular ring is housed about (a pin) in a hose conveying the drug, one tubular ring being located between said former hose and a rigid wall, being filled with auxiliary fluid via an electrically operated pump whereby the drug steam in the hose is stopped.

20 96. A device according to claim 1 or 2, wherein a pin inside of the drug conveying hose is enclosed by shutter-type lamellas constricted to throttle passage flow by way of piezo-electrical voltage transformers functioning as pressure transducer.

25 97. A device according to claim 1 or 2 and 93, wherein two double-acting cylinder piston pumps each are electrically operated in such manner that the central one of three tubular rings respectively communicates cavity-wise with the output of both cylinders simultaneously.

30 35

98. A device according to claim 1 or 2,
wherein at least one electromagnet acts by the
short lever arm on plates connected via a hinge
or joint thereto, with the drug conveying hose
being guided between said crossing short and re-
silient lever arms in an acute manner between
the plates and via two crossing lever arms still
further to the cannula in a manner such that
by pulsed actuation same amounts of the drug
are conveyed.

99. A device according to claim 1 or 2,
wherein a conic envelope having a spiral type
interior ledge acts, via an elastic cone with a
spiral shaped border ledge -whereon the drug
conveying hose is mounted- via electric drive,
when lowered upon the hose in such a manner that
the upper windings of the hose are squeezed ear-
lier than the lower one and a peristaltic dosing
movement is performed which is blocked by the
action of a barrier placed under a hose winding,
and this when resetting of the conic envelope
takes place.

100. A device according to claim 1 or 2,
wherein an elastic envelope or shell sleeve is
provided in whose hollow space or cavity a hose
enlargement is located whose inputting leg is
guided flat above the rim border of the shell
or envelope ring, said hose enlargement being
connected, on the side of the cover, to a plate
which is connected via overlying piezoelectrical
pressure transducer so that, when approaching,
the inputting hose leg is first pinched off and
then the hose enlargement is partially emptied
through the cannula, a light source cooperating
with sensor to control the contents level of

the hose enlargement while the stroke height of the pressure transducers is controlled by a piezoelectrical switch.

5 101. A device according to claim 1 or 2,
wherein measuring or test electrodes are provided on the drug conveying hose, the measured data relative to electromagnetic changes of
10 state being transmitted as a function of flow rate to a control unit commanding an electric locking valve, with the drug fluid from the supply reservoir being pressured.

15 102. A device according to claim 1 or 2,
wherein the ends of the drug hoses are formed as hose ends bent at an angle connected to bores of the central supporting tube for the cannula magazine, which bores are conical on their sides.

20 103. A device according to claim 1 or 2,
wherein a central pin adjustable in height inside of the suction cup activates a snap-in device which acts upon the position of the cannula inside of the cannula magazine.

25 104. A device according to claim 1 or 2 and 103,
wherein a central pin adjustable in height inside said suction cup surmounts the suction cup rim prior to vacuum generation and for tripping or triggering same.
30

105. A device according to claim 1 or 2,
wherein connected after a pressure gas capsule is a valve combination comprised of two seat
35 valves, the smaller one of which being opened first, and a slide valve, in terminal position of the slide valve gas pressure is accumulated

in an high-pressure chamber towards the seat valves whereby opening the large seat is facilitated.

5 106. A device according to claim 1 or 2, wherein a swelling pin, underneath a pressure gas capsule, is housed inside a tube, which pin urges, upon fluid being added, the pressure gas capcule into the mandrel with the groove for gas
10 relief.

107. A device according to claim 1 or 2, wherein a supporting arm with accumulator tube operastes to accomodate used-up cannulas in or-
15 der to connect a plug-in part for drug replacement to the apparatus via a fixing spindle.

108. A device according to claim 1 or 2, wherein lateral flaps are provided which are
20 closed by spring action used for the control of the operation of the apparatus while indicating, at same time, the operating conditions.

109. A device according to claim 1 or 2, wherein in the vicinity of the cannula a cylin-
25 drical pump housing(111) is interconnected without break by sections of said hoses, possibly of material composition thereof or unimpeded expansion from outside, in which housing a rod (110) is embedded with rod drives alterningly
30 a seal member(109,163) and a valve lock(115, 169), the power being provided from said disk (112) perforated with passages for the liquid of the drug or preparation and effected at the
35 rod via a clamping device(113,171) and the linkage(122,126) thereof by a motor, the number of pumping strokes of said rod for the respective injection being determined by means of a mechanism for preprogramming the dosage, and

said injection being triggered as soon as the skin in the suction cup is lifted or raised.

5 110. A device according to claim 1 or 2 and 109, wherein said seal member at the rod is comprised of a collar(109) directed against a plug (114) through whose central bore the rod penetrates towards the cannula and which bore is closed by means of a projection(115) of the rod
10 with the counter stroke for having the collar bear against said punger.

15 111. A device according to claim 1 or 2 and 109, wherein said pump housing(111) proper is formed by said hose(44) limited as to expansion by the inflexibility of the internal composition of the material or from outside by fixing envelope(116).

20 112. A device according to claim 1 or 2 and 109, wherein the motor is constituted by a spiral(31) acting on two wheels(117,125) rotatable about said pump housing, which wheel comprising each circular profil ridges or ledges facing one another
25 to which resilient(121,127) rods(122,126), acting as sensors and guarded against rotation with respect to the axis of said pump housing, communicate their stroke travel to the disk(112)
30 at the valve rod within said hose(44).

113. A device according to claim 1 or 2 and 109, wherein said motor constituted by a solenoid(170) whose spring-back resilient pendulum movements
35 are transferred to said disk(112) within said hose(44), the number of pulses for respectively one injection being presettable in a unit (175).

114. A device according to claim 1 or 2,
wherein the drug supply reservoir(20) is con-
stituted by bellows whereabove a cover is dis-
posed, which cover can be adjusted in height,
5 which displacement being coupled via a power
transfer mechanism(132 to 137) with the moment
for for the pump in keeping with a presettable
dosing in such manner that the amount of drug
fluid delivered through said cover corresponds
10 to that displaced by said pump.

115. A device according to claim 1 or 2,
wherein said drug reservoir is constituted by
said bellows supplied within a gas tight vessel
15 with gasifying reagents, the manner in which
said reagents are kept relative to one another
causing a delayed and gradual delivery of gas,
and a pressure relief valve being provided on
said vessel so as to keep the pressure on said
20 drug fluid nearly constant.

116. A device according to claim 1 or 2 and 115,
wherein for gas production a bicarbonate com-
pound is brought up to a sheeting or foil,
25 which will be exposed to the influence of
hydrochloric acid inside of a gas pressure
container, said foil being piled up in thin
layers.

117. A device according to claim 1 or 2,
wherein a control line is provided between the
drug reservoir in the direction towards the
cover, which line causes on account of the de-
crease in size of the drug reservoir an alarm
35 to be tripped shortly before the drug supply
will be exhausted.

118. A device according to claim 1 or 2,
wherein a program may be provided within the
unit(175) for electronic control of preset-
table dosing so as to actuate the alarm prior
5 to an exhaustion of supply, and to block the
function of the injector in a recognizable man-
ner as soon as the dispensation of the next
dosis is no longer assured.

10 119. A device according to claim 1 or 2,
wherein an adjustable obstacle(142) is provided
so as to prevent the cover(138) to descend
further briefly before the supply has been ex-
hausted and to block conjointly therewith the
15 functioning of the injector.

120. A device according to claim 1 or 2,
wherein for the preservation of negative pres-
sure a vacuum source is provided by a member
20 adjacent to the suction cup and part of a cylin-
der(5) with cover, and wherein sensing means
(69 to 74) are provided on the injector so as
to detect an altered surface due to subsiding
negative pressure on each cylinder subsequent
25 to skin contact, which alterations control the
continued operation of the working cycle of
the injector.

30 121. A device according to claim 1 or 2 and 120,
wherein said sensing means are constituted by a
feeler(74) mounted as angle bracket on a drum
(71) lifted up by a rammer(69) of lengthwise
flattened cross section against a spring with
35 the rim of said vacuum preserving or retaining
cylinder(5), wherein said drum is rotated by the
action of a connecting link guide(72) therein
on a fixing or guide pin(73) in such a manner

that said rammer abandone its seat on the cylinder wall and a notching in the contactor pin(66) extending the axis of said drum and coming to rest above a wedge(75) with said feeler pivoting to the cover membrane(6) of said vacuum retaining cylinder(5) where it descends upon immersion and because there is no longer support by the pin(7) about the cannula shaft from said border membrane(10) to said suction cup, the notching in the contactor pin being descended in the vertical in keeping with said connecting link guide and actuating said wedge for further tripping the functions of the injector.

122. A device according to claim 1 or 2 and 120, wherein bellows(96) are squeezed by a rammer(69) resting on the wall of a vacuum preserving cylinder(5) when it is raised by sliding the cylinder(5) into the injector, air streaming into the pneumatic cylinder(98) via line(101) and a nonreturn valve and descending the piston and hence also the rod of the slide valve(99) penetrating into the windows(85) of the elastic membrane on the otherwise fixed cover membrane of said cylinder(5), resetting however said slide valve again, when lifting the window membrane as a consequence of the subsiding vacuum or negative pressure in said cylinder(5) subsequent to pressure compensation, towards the suction cup occluded by the skin, whereupon said bellows are reventilated via said opened slide valve and said line(100) so that the drum(71) totable connected thereto descends in keeping with its connecting link guide on the fixing or guide pin(73) and causes said wedge or drop-in pin(73) to be tripped such that said injector proceeds with its operation.

123. A device according to claim 1 or 2 and 40,
wherein said injector supports locking means
(148,149,154,155) for the bottom cover(9,165)
comprising attachment means(165,207,208) there-
for, which are removed in keeping with the pro-
visions and prior to the applying said injector
after said locking means of the injector have
become operative.

124. A device according to claim 1 or 2 and 123,
wherein said locking means of the injector are
comprised of locking lamellas(149) parts of
which, being excentrically, mounted with an
axis(155) each on a ring(146) fixed relative
to the injector with the rotation of a control
ring(154) connecting an axle pin(158) each there-
with, are displaced in the direction into and
out of the notching(150) in the region of the
annular piston or said bottom cover(9) of said
cylinder(5) preserving the vacuum.

125. A device according to claim 1 or 2 and 124,
wherein said control ring(154) is rotated
against a spring from three pins(148) in the
suction cup range for actuating said locking
lamellas(149), which pins being lifted beyond
activating the tripping or release action of
said locking lamellas within their passage
past and through said control ring.

126. A device according to claim 1 or 2,
wherein the rotation of the control ring(154)
unblocks from three pins in the suction cup
range or area the openings for the release or
tripping tabs(187) above said control ring in
such a manner that by having the latter descend
the continued functions of the injector will be
tripped or triggered.

127. A device according to claim 1 or 2 and 40,
wherein the tripping pins(148) for the conti-
nued functions of the injector are located
within bays or indentations of a clover-lobe
5 shaped suction cup rim external of the suction
cup chamber.

128. A device according to claim 1 or 2 and 40,
wherein said suction cup is formed at least in
10 part by the injector whereinto said vacuum pre-
serving cylinder(5) sealed with respect to said
suction cup will be pushed or slid.

129. A device according to claim 1 or 2 and 41,
15 wherein the injector is provided with spring-
suspended contactor buffers(81) acting on a co-
ver membrane(6) projecting over the wall of
said vacuum preserving cylinder or vacuum re-
servoir cuplet(5) for assuring fixation there-
20 cf.

130. A device according to claim 1 or 2 and 41,
wherein the locking means of the injector com-
prise locking pins(204) acting through thinwal-
25 led bulges(206) of said vaccum preserving cy-
linder(5) in a manner so as to lock the movement
of the support cylinder(205) supporting the
border membrane(10), on which cylinder a cen-
trally pierced bottom cover(165) laterally pro-
30 jecting above the border membrane is attached
with its central part, while the rim extending
alongside of a predetermined breaking ring
(208) and supporting the wall of said cylinder
(5) is removed prior to the injection.

35 131. A device according to claim 1 or 2 and 41,
wherein a hoselet(209) closed by a clamp(210)
extends from the adapter funnel for the cannula

adapter piece of the injector, which funnel projects somewhat above the cover membrane(6) of the vacuum preserving cylinder or said vacuum reservoir cuplet(5), to a small ball for checking the vacuum as well as the position of the cannula with respect to the blood vessels.

132. A device according to claim 1 or 2 and 40, wherein the suction source comprises a resistance heated boiler(172), wherein the heated air may escape through the valves(184) and the vacuum may be preserved until the valve opens between boiler and suction cup chamber for sucking up the skin.

133. A device according to claim 1 or 2 and 132, wherein said boiler is subdivided into a plurality of chambers(174) with separate valve means for each individual chamber.

134. A device according to claim 1 or 2 and 132, wherein said boiler(172) comprises a double-walled cylinder the lower portion of which encloses said suction chamber.

135. A device according to claim 1 or 2 and 40, wherein for the reventilation of said suction cup chamber a tripping mechanism is provided whereby the tension of a spring(64,104,105) is arranged for prior to the standstill of the motor effecting the delivering or dispensation of the drug fluid, a locking member(59,99,159) being retained by a grid(58,62,108,160,161,163) for so long until said locking member at the steep flank(162) of the fixed housing link unblocks the movement by said spring(64,105) subsequent to the delivery or dispensation of the drug fluid.

136. A device according to claim 1 or 2 and 40,
wherein said mechanism for reventilation the
suction cup chamber comprises a mandril(89)
having a tripping bar(60) which is raised or
5 lifted against the action of a spring when
the vacuum preserving cylinder(5) is pushed
or slid in so as to pierce the cover membrane
(6) of said cylinder(5) upon actuating said
tripping mechanism.

10 137. A device according to claim 1 or 2 and 40,
wherein said mechanism for reventilating the
suction cup chamber comprises a slide valve(99)
communicating via a hose(156) to ambient air,
15 wherein the tension of said spring(105) is pro-
duced by the pressure effect of a tongue(82)
or tab, having been moved past it, onto the
wedge slant of a valve rod(106), and wherein
the housing of the slide valve(99) is displa-
20 ced against the compression spring(104), a
locking mechanism(108) preventing the return
of valve rod into a valve open situa tion for
such a length of time until said slide valve
effects snapping engagement of said locking
25 mechanism(108) by said tongue or tab under
the action of said spring(105) subsequent to
passing the wedge slant whereby effecting the
return of said valve rod under the effect
of said spring(105).

30 138. A device according to claim 1 or 2 and 40,
wherein the tension of the spring(105) for re-
turning the valve rod via an elastic manual
lever(161) is effected, while the slide valve
35 (99) is closed, against the action of said
spring(105) and abutment on the disk(225)
displaced conjointly with the discharge of,
the drug, whereupon by the descending the
manual lever into an abrupt constriction of

the connecting link at the housing the follower (163) will snap into the bore of said disk(225) and will first unblock the movement of said spring(105) after the manual lever has returned
5 via its steep flank of its link at the housing by having said manual lever spring upwards, said spring(105) effecting via the hose(156) a reventilation of said suction cup by displacement of the valve rod.

10 139. A device according to claim 1 and 3, wherein a cannula shaft, behind the ground surface and sustaining ring closure thereof, is opened duct-like, the lacking wall being replaced by
15 an inlay of synthetic material and endowed with sensor properties.

140. A device according to claim 1, 2 and 3 with a cannula which has a hoslet inside so
20 shaped that its end leaves the cannula shaft by influence of fluid pressure.

141. A device according to claim 1 or 2, wherein counter wheels are present which are
25 rotated by the movement her to and from of a pinion respectively to the frequency of use and the blocking of whose effects the blocking of the function of device by a stop.

142. A device according to claim 1 and 2, wherein said cannula is developed as optical
30 sensor by introducing light through the cannula shaft, which is reflected at a indicator layer, being altered in such a manner that alterations
35 of metabolism are identifiable by means of a detector.

143. A device according to claim 1, 2 and 142, wherein polarized light is introduced through the cannula shaft, which is led about a mirror into a detector.

5

144. A device according to claim 1, 2 and 142, wherein the light is introduced through light transducing fibres into said cannula.

10

145. A device according to claim 1 and 2 and 142, wherein the light is projected directly by an opening of the cannula shaft and received again through that.

15

146. A device according to claim 1 and 40, wherein polarized light is projected and received inside of a suction cup nearly to the cannula through the skin which is raised.

20

147. A method for manufacture of a vacuum retaining cylinder or reservoir cuplet(5), characterized in that in two form parts(215) of an injecting mould there are formed vacuum retaining cylinders and annular pistons(9) side by side, carrying them via transport means(211,212,213) of the annular piston first to a border membrane (10) -cutting and bonding same-, affixing attachment means(165) at the annular piston and finally bringing together said annular piston and attachment means with the border membrane in a seal housing comprising a cylinder(5) having a fixed cover membrane(6) as second part, removing extensively the air from said seal housing via a pump and uniting both parts with the border membrane as joining surface by bonding such that after removal of the vacuum retaining cylinder cuplet said attachment means prevent the annular piston from sliding into said cylinder.

35

148. Medico-technical device for the automatic injection of fluids under the skin of man or animal, in particular for the injection of insulin in treatment of diabetes. The injection device thereby consists of:

a) a proper injecting syringe, which again consists essentially of a syringe cylinder and a syringe piston and a supply container,

b) of means for determination of the concentration of the respective values of blood (respectively of the deviation from the normal values) of the living beings (man or animal), there particularly means to determine the glucose concentration of blood of patients suffering from diabetes which need treatment,

c) means for the calculation of the amounts of fluid which is need according to the measured and from the normal values deviating values of blood, there particularly for the calculation of the amounts of insulin which is needed for the treatment of the measured sugar contents of blood,

d) means for the dosing of the fluid amount and of providing in the syringe cylinder, there particularly means for the dosing of insulin,

e) means to introduce the fluid under the skin of the living being, and is

significated thereby, that a cannula which serves to introduce fluids together is developed ad sensor-changor which as intended after the introduction of the cannula onto the body of the living being determinates the concentration of the questioned components of body, particularly of status of metabolism (e.g. glucose-contents) inside of the body by means of physico-chemical change of conditions.

149. Injection cannula as claimed in
Claim 1, 2 and 148,
s i g n i f i c a t e d t h e r e b y ,
that the sensor surface of the cannula serves as
as an active electro-chemical element in connec-
tion with the body liquid of a living being and
by means of a counter-electrode.

150. Injection cannula as claimed in
Claim 1, 2 and 148,
s i g n i f i c a t e d t h e r e b y ,
that the sensor surface of the cannula alters its
electrical resistance in a legal manner and in
such which may be reproduced by the influence of
the body liquid of the living being, and whereby
is available for evaluation either a voltage
proportional to this resistance, respectively the
alteration of said voltage with the times, or
the current intensity proportional to said resi-
stance, respectively the alteration of said
current intensity with the times.

151. Injection cannula as claimed in
Claim 1, 2 and 148,
s i g n i f i c a t e d t h e r e b y ,
that a sensor is present at the cannula, which
decides the concentration of the questionable
body liquid by means of light-conductors, which are
taken with within or at the cannula and such by
photometric way.

152. Injections-device according the dominating
notion of claim 1, 2 and 148,
which contains a means of the
production of a negative pressure at the body
surface which is to treating(so-called "suction
cup"),
s i g n i f i c a t e d b y

auxiliary aggregates with the assistance of those is secured, that

a) the ejection of the injection fluid under the skin events first after the building-up of the negative pressure is concluded,

and that

b) the reventilation events first after the the injection is performed, and that automatically, and whereby the suction cup rim serves as counter electrode during the measurement.

153. Injection device as claimed in Claim 1 and 152,

significated by

a computer building-stone with aid of which the dosing and the injection of fluid events automatically after the (pre-)programming and starting of the program.

154. means according claim 1 and 148 (especially 1c) for

the calculation of the amount of fluid which is needed for the injection,

significated by

a) an input measuring unit for the reception and processing of the signals delivered from the sensor cannula,

b) a program unit (with time donator) for the (pre-)programming of commands,

c) a computer unit for the evaluation of dates given from the sensot and from the program unit and

d) a command-unit for the transmission of the resultats of calculation as commands toward the dosing device.

155. (Pre-)programming unit according Claim 1 and 154b,

significated by

adjustability of a predestinated "normal" dose.

156. A device according to claim 1 or 2,
wherein means are present for supervision of
the exhaustion of drug supply, these means
as to activate an alert or alarm device and as
5 to lock the functions of the device, if the de-
livery of a sufficiently dosis no longer is
guaranteed.

157. A device according to claim 1 or 2,
10 wherein means are present to set in swingings
or to vibrate the dosing device, at least said
hose section which is nearly to the cannula,
and this for blending or mixing the compounds
of the drug or medicine.

15 158. A device according to claim 1 or 2 and 41,
wherein the reventilation of said section sup-
results through a nozzle or jet.

20 159. A device according to claim 1 or 2 and 41,
consisting of a housing cylinder(1), a bottom
or basic ring, a folded bellows which extends
from the proximity of the latter towards a pi-
ston, of a tube tube socket for connection with
25 a push-in or inserting cylinder for taking up
an injection syringe, whereby a reventilation
valve exists and a device for a temporary
blocking of backward movement of said piston
as to unfold again said folded bellows, after
30 the interior space of latter have been con-
nected with a suction source through a drain
or derivation hose and the skin of the patient
have been closed .

160. A device according to claim 1 or 2 and 159,
wherein a tent-like membrane is provided between
a central sliding tube and the piston as to
render possible a backward movement of said
5 sliding tube and the syringe even though said
piston has been fixed.

161. A device according to claim 1 or 2 and 159,
wherein said inserting cylinder contains a sli-
10 ding shell, which lifts the syringe by a preter-
mined extend out of the range of the suction cup
rim by means of a spring, which syringe on the
contrary will be sunk towards the suction cup
by pressure effect from the piston which is mo-
15 ved by the effect of suction.

162. A device according to claim 1 or 2 and 159,
wherein a piston ring is fastened on said piston,
which ring bears magnets which are adjusted to-
20 wards the iron covering plate of the inserting
cylinder wherewith these may be touched.

163. A device according to claim 1 or 2 and 159,
wherein pegs are mounted in a transversal bore
25 or cross-bore which are moved by means of a
slant in a blank of the housing cylinder and
the notch of the sliding tube for locking of
the piston movement.

30 164. A device according to claim 1 or 2 and 40,
characterized by an injector composed of a fol-
dable drug supply bag and of a support or carrier
disk(40) constituting means for adjusting the
delivery of the drug or preparation through the
35 hose in accordance with a preselected variable
dosing thereof, which support disk carries two
facing rollers(41), surrounds said hose(44) in
a recessed chamber, squeezing said hose against

an annular encircling abutment(43) with said
rollers, and is provided with a sectoral pas-
sage, said hose outside of said passage being
surrounded by an expansion-resistant envelope
5 (45) up to the cannula(8) within the suction
cup, the power source for the displacement of
said carrier disk being constituted by a spi-
ral spring, the displacement being effected
via a locking toothed wheel or ratchet with
10 pawl(30) in the pressure tension release means
of said spiral spring, resilient tabs(27) con-
stituting the stops as means for presetting the
dosage prior to the application, and which stops
being settable along a scale or graduation where-
15 by said carrier disk is prevented to come in
contact with a contactor pin(66) which is with-
drawn for a short period of time through a pro-
file link(67) subsequent to a sectoral motion
of the disk(51) driven by special spiral
20 spring(55) and part of the vibrator means, which
disk hold regularly spaced pins engaging the
annularly traversing wedge profile ridge or
ledge(76) alongside of the carrier disk and com-
municating thereto thrust-type motions transverse
25 to the axis as soon as it has been lifted into
the cannula after suction has been exerted on
the skin within the suction cup.

165. A device according to claim 1 or 2 and 159,
30 wherein, if said inserting cylinder approaches
to the suction cup, a pin shoves against a con-
tact spring which thereby contacts with the
cannula shaft.

166. A device according to claim 1 or 2 and 164,
35 wherein at least two hoses are arranged parallel
on the carrier disk and reunited in front of the
cannula attachment piece.

167. A device according to claim 1 or 2 and 164,
wherein means(48,88) have been provided whereby
a fold-free housing or lay-out of the hose is
assured within the grooved chamber(288).

5

168. A device according to claim 1 or 2 and 164,
wherein roller pairs facing one another squeeze
the hose together.

10

169. A device according to claim 1 or 2 and 167,
wherein a tension spring(48) extends as safety
means from the hose exit away from the passage
of the annular abutment(43) to the housing.

15

170. A device according to claim 1 or 2 and 167,
wherein threads extend rope-ladder like between
the hoses(44) about the stationary bridge(88)
of a gear wheel.

20

171. A device according to claim 1, consisting
of at least one temperature feeler arranged in
such a manner that differences of temperature can
be ascertained in the area of the skin knob.

25

172. A device according to the claims 1 and 2,
consisting of at least one temperature feeler for
comparing differences of temperature at the
state of a blood-less skin with a such of blood-
fullness.

30

173. A device according to claim 1
consisting of a photometric measuring arrangement
with at least one ray source and at least one
sensor for checking differences of density at the
area of the skin by comparison of the extent of
the ray absorption.

35

174. A device according to the claims 1 + 173 wherein said ray source emits polarized light for checking of conditions of metabolism at the area of the skin.

5

175. A device according to the claims 1 + 173, wherein at least one reflex-photometric measuring arrangement is present.

10

176. A device according to the claims 1 - 173, wherein a plurality of emitters vertically arranged work against sensors vertically arranged too, in such a manner that the raising and stop of motion of the skin knob may be ascertained .

15

177. A device according to claim 1 + 173, wherein a plurality of emitters which are vertically arranged work against sensors which are vertically arranged to for checking the thickness of skin layers by evaluation of differences of density and absorption.

20

178. A device according to the claims 1 + 173, wherein at least two emitters are arranged with a distinct angle shifting preferably with such of 90 degrees for checking the possibility of the presens of a blood vessel by the simultaneously decrease of the ray intensity.

25

179. A device according to the claims 1 + 173,
wherein the distinction between different substitutes of the skin is facilitated by the choice of the kind of rays.

5

180. A device according to the claim 1+177,
wherein simultaneous measurements of a plurality of sensors are provided, to find out the thickness of the skin layer after the stand-still of the skin knob is ascertained by the pattern of alternation of measuring data by means of different extinction of rays tangentially projected or radiated through the skin knob

10

15

181. A device according to the claim 1 +177,
wherein the subsequent alterations of light absorption by at least two sensors are used to check the thickness of the skin and whereby the velocity of the skin raising is included for evaluating, measured by the comparison of the at the time at which the skin knob passes a beam.

20

182. A device according to the claims 1 +172,
wherein the comparison of measurements of a sensors, which also may be arranged horizontally, takes place using the characteristic of the change of measurements by regularly distanced sensors to check the density, number and extent, of vessels by calculation

25

30

183. A device according to the claims 1 +173, wherein the comparison of the measurements by at least two nearly positioned sensors by computer elements is used to check an exceptional limited density under the skin with the aim to break off the elevation and the subsequent functions of the device.

184. A device according to the claims 1 +173, wherein the skin has a fixed relation of position towards at least one measuring arrangement, at least partially working tangentially to the skin knob to coordinate the known distances of the ray path through the skin area with the measured extinctions.

185. A device according to the claims 1 +173, wherein at least one second measuring arrangement is provided with fixed angle shifting, as to a calculatory coordination of of the interception points of rays of different arrangements for localisation of irregularities of ray extinctions.

186. A device according to the claim 1, wherein changes of measuring values in the area of at least one sensor is used, to interrupt an injection under the skin and to actuate a warning device.

187. A device according to the claim 1, wherein between a handle grip of an injector with functional constituents and a suction cup exists a spring connection, tensioned during an approximation of both parts by manual pressure, while adjustments of their surface common together prevent movements outside of their common axis, but said spring keeping in distance both parts if the manual pressure is released, all this

to avoid a reventilation of the suction cup by tilting by means of the lever effect caused by the length of said handle grip.

188. A device according the claims 1 +177, wherein the handle grip is replaced by a kind of over beaker which surrounds the injector cup-like.

189. A device according the claim 1, wherein a suction injector is used with at least one switch between the outer suction cup rim and inner rand zone destinated for latter abutment of the raised skin, which is activated at a first step by skin contact, but which starts the injection not earlier as when the skin contact is interrupted again during the reventilation of the outer sealing area at a second step.

190. A device according to the claims 1 +189, wherein instead said switch at least one channel opening communicates with a kind of suction switch, the backwards movement of which activates the triggering mechanism for the dosing pump.

191. A device according to the claim 1, wherein a suction injector has inside of its housing opposite to the drug container an accommodating cylinder to receive an replaceable suction cup so that its supporting plane towards the skin is enlarged.

192. A device according to the claims 1 and 20, wherein said replaceable suction cup is a vacuum reservoir cuplet, whereby said injector has at least one dropping lever which can be activated by the same adjusting ring which also serves to the pre-adjustement of the dosage.

193. A device according to the claims 1 +192,
wherein the dropping mechanism is activated by a
over-taking mechanism inside of a clearance
for the motion of the adjusting ring, said drop-
ping mechanism being slidable arround to a dosage
5 spatium together with a lever for the dosage stop.

194. A device according to the claims 1 +191,
wherein a device for photometry can be plugged in
10 an atleast partially transparent vacuum reservoir
cuplet arround its circumference.

195. A device according to the claims 1,
wherein a dosing pump exists in the area of the
15 drug discharge from the fluid container which
pump is integrated into the hose and consists of
a ventil mechanism which releases periodically
alternating the discharge and afflux to a dosing
chamber inside of said hose in this area laying
20 inside of a solid pump housing the pressure gas
bolster of which presses against said hose wall
whereby the pressure of said bolster falls short
of the pressure inside of said drug container so
that the drug is discharged into the body as
25 mettered single dosages.

196. A device according to the claim 1 +195,
wherein the end of the rod of said dosing pump
enters through the drug-outlet of a supply con-
30 tainer blocked there inside of a bush which is
embedded at the bottom of the niche of a folded
bellows to be fixed there with its end cone by
a spring when said niche was descended with
exhaustion of the drug.

197. A device according to the claims 1 -195,
wherein said pump rod which is embedded in said
hose has a sharpened point to pierce a sealing
membrane bordering to a vacuum reservoir.

5

198. A device according to the claim 1,
wherein a suction injector has a vacuum reservoir
cuplet which has around the cannula shaft a bush
closed by an elastic membrane towards the outer
10 air and which towards the cuplet cylinder is kept
at first by an untractile membrane enabled
to crush by pressure against the bush, whereby
air enters into the space beneath said membrane
bordered by a second but compliant membrane,
15 which also extends from said bush to said cuplet
cylinder and which is moved by the influence of
the manual pressure and by the effect of air
pressure in the direction away from the cannula
tip whereby a cover plate with a cutting edge
20 works cutting against said bordering membrane, so
that the skin is enabled to raise into the can-
nula.

199. A device according to the claims 1 -198,
25 wherein a border membrane has an adhesive
layer to support the raising of the skin.

200. A device according to the claims 1 -42,
wherein the support of a sealing border membrane
30 has a central bush with a rotatable abutting disk
with outer projections abutting against corre-
sponding inner projections of the cuplet, whereby
at the injector at least one lever consists ef-
fecting the revolution of said abutting disk,
35 after which the bush is drawn upwards by the
effect of air pressure.

201. A device according to the claim 1, wherein a storage of pressurized gas is connected by a nonreturn valve with gas storing compartment therefrom being a pressure regulating valve towards the elastic bag for a drug supply, all that as components of an suction injector.

202. A device according to the claim 1, whereby inside of a step syringe for multiple use the separation piston includes a little dosing piston which displaces drug fluid towards the cannula by periodical strokes said separation piston being prevented also periodically for movement by cross-pins struggling against the cylinder wall of said step syringe by a conical portion of the rod of said little dosing piston, which is driven by a solenoid.

203. A device according to the claim 1, whereby inside of a step syringe the separation piston is partially surrounded by a hose ring which is periodically filled with auxiliary fluid by a little pump, so that said hose ring locks, first, the lowering of said separation piston and displaces than a mettered volumen of the drug towards the cannula.

204. A device according to the claim 1, wherby within an injector a dosage mechanism is used with one motor for the dosing of two different drugs, said motor running in opposite direction for each dosing mechanism which operates only in one direction while the other one is locked by a ratched wheel and pawl.

205. A device according to the claim 1, whereby inside of a drug container with a folded bellows as isolating supply bag at its end a tape-measure is fastened which leads behind a window of the cover as to indicate the state of filling always

The claims defining the invention are as follows:*

1. A device for the automatical self-control of metabolism of a mammal, consisting of at least one sensor which is to be connected with a measurement device and which is arranged in relation to a skin knob produced by a mechanical apparatus in such a manner that an additional pressure of the body may be avoided for the measurements.

2. A device for the automatical self-control of metabolism of mammal, consisting of a sensor arranged at least near to a cannula which permits to measure alterations of metabolism without accessory injury.

3. A device according to the claims 1 and 2, wherein the cannula itself is developed as sensor to prepare alterations of the metabolism in the body for the information.

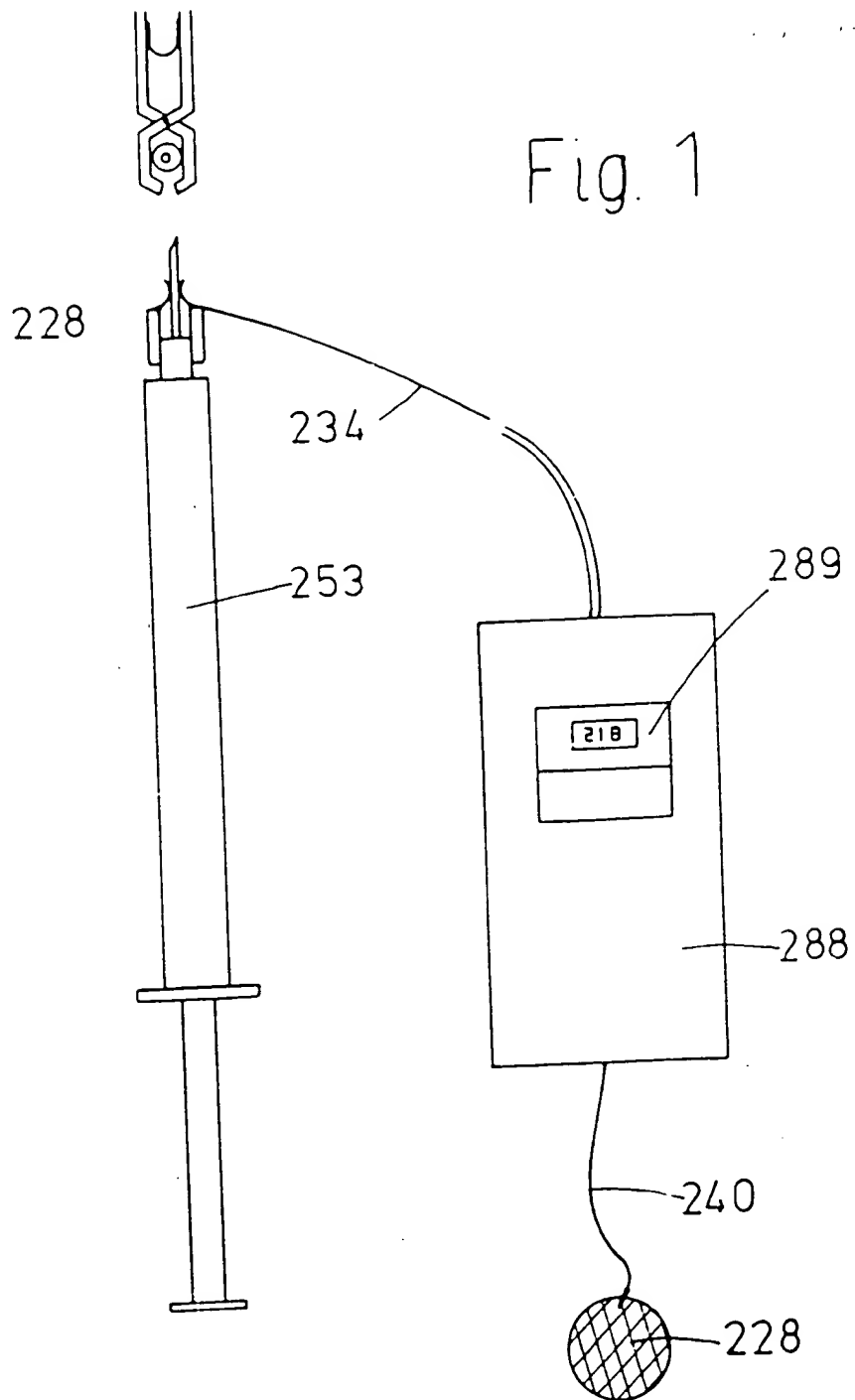
4. A device according to claim 1, 2 and 3, wherein special insulating zones with respect to conductivity are provided between cannula shaft and the duct-like opened shaft.

5. A device according to claim 1 and 2, wherein a small hose having sensor properties is attached on at least one portion of its surface, and this in tight connection with the drug feeding channel within the duct-like opened shaft.

Dated this 15th day of March, 1986 WAGNER
WOLFGANG NAME OF APPLICANT
(BLOCK LETTERS)

*Note: If there is insufficient space above to type the statement of claim, do not use this sheet, but use separate sheets of paper beginning with the words "The claims defining the invention are as follows:" and ending with the date and the name of the applicant in block letters.

Fig. 1



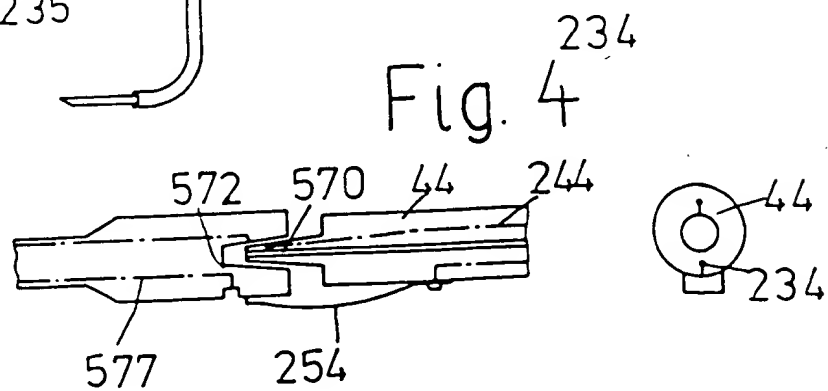
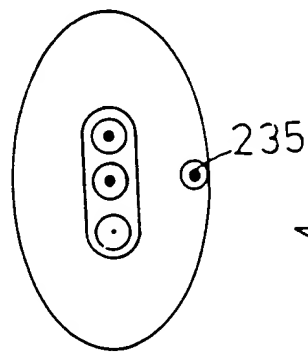
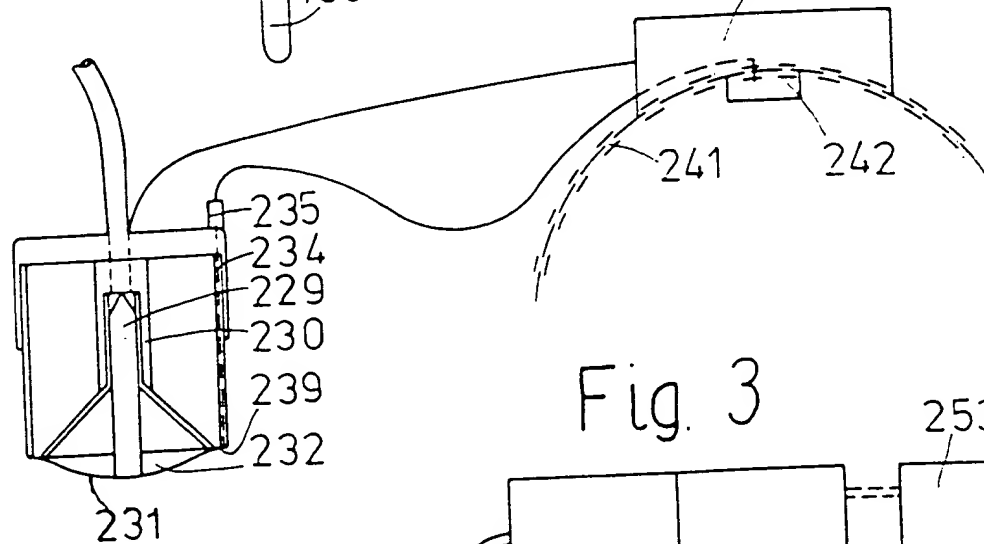
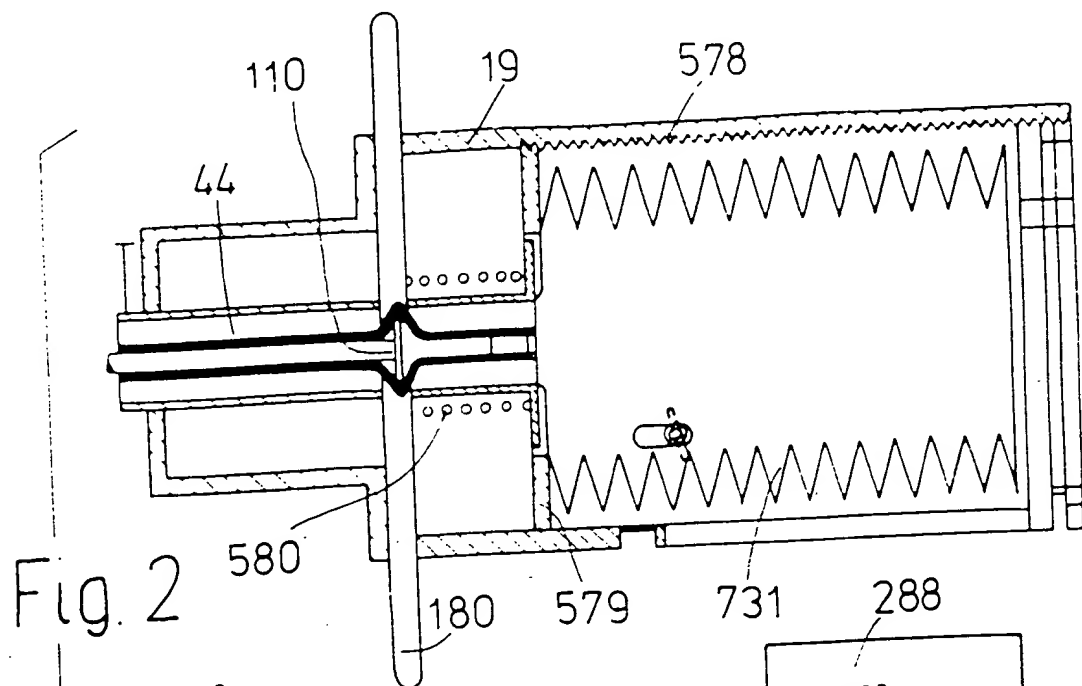


Fig.5

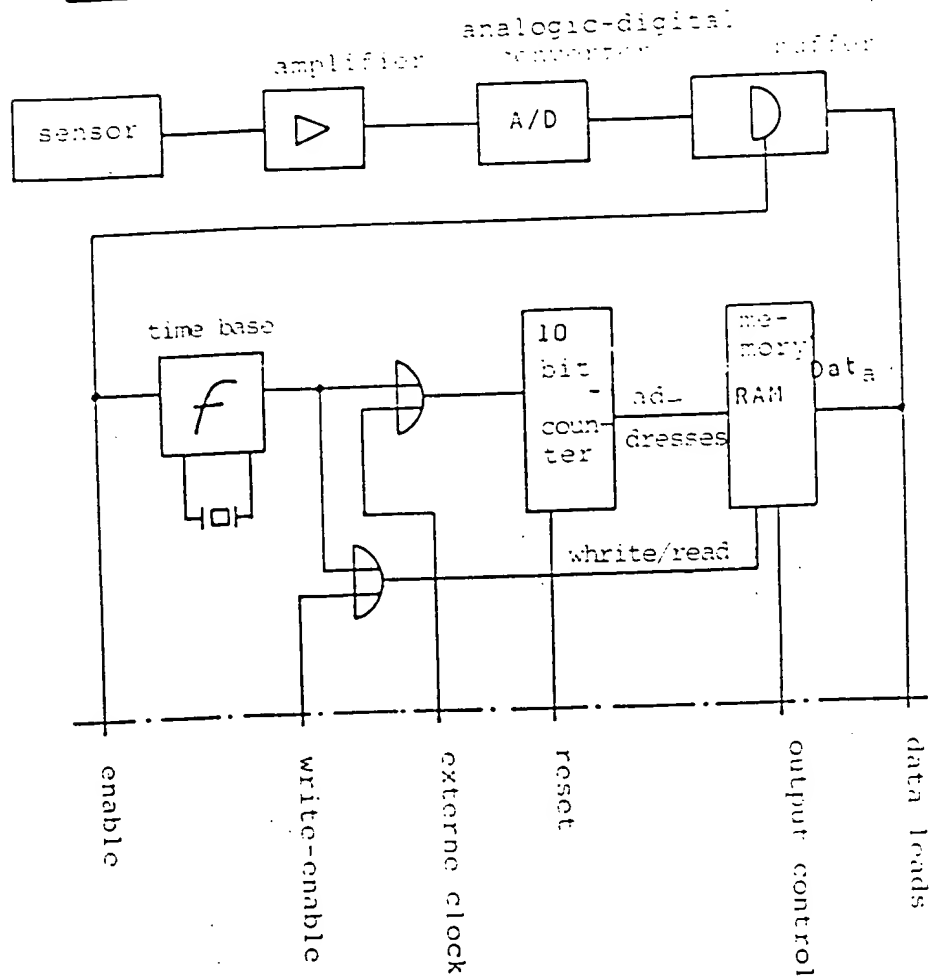
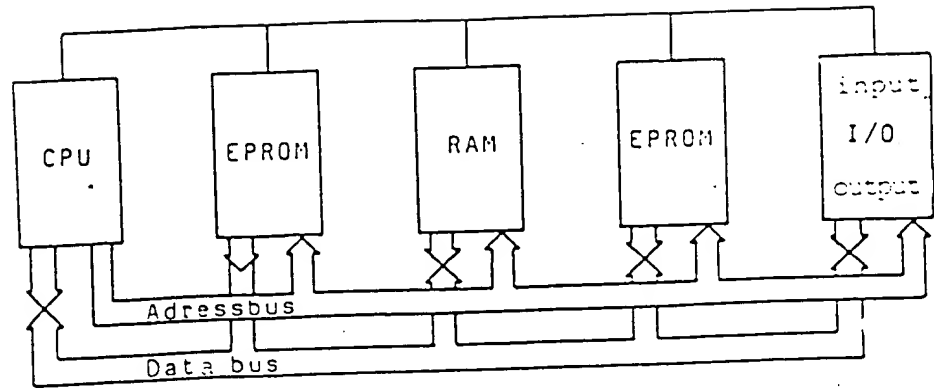


Fig.6

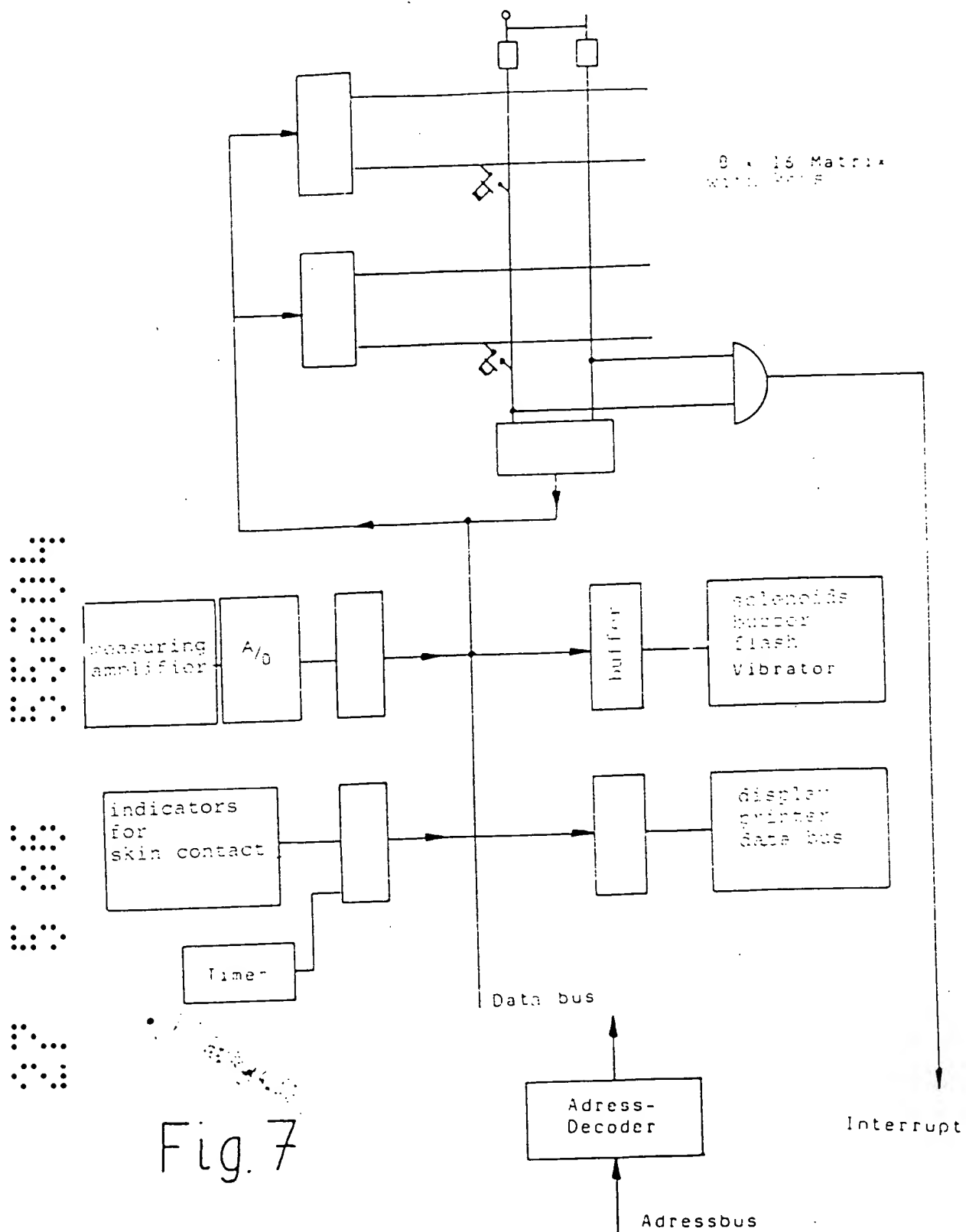


Fig. 7

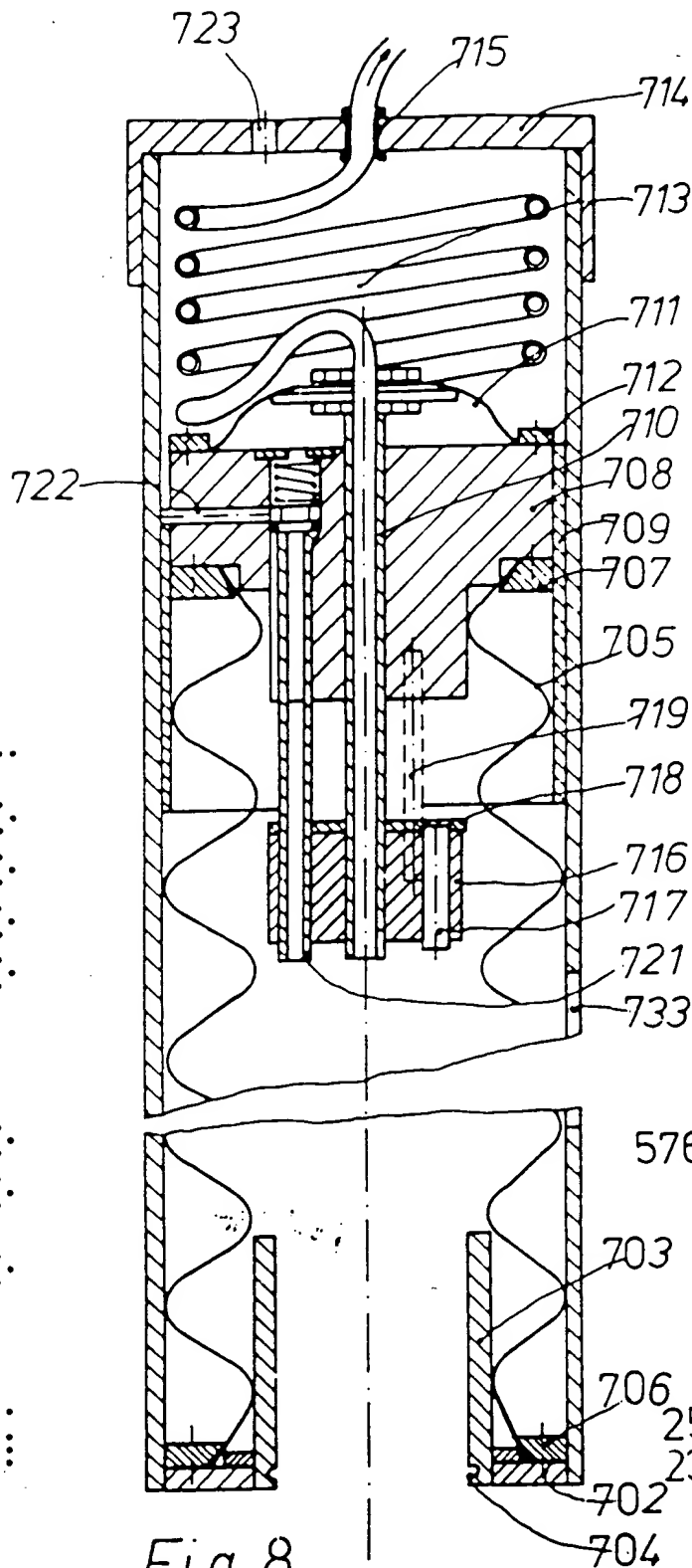


Fig. 8

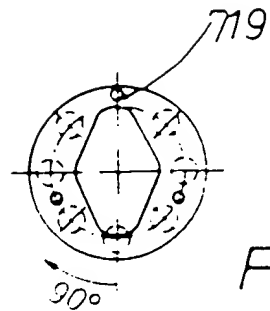


Fig. 10

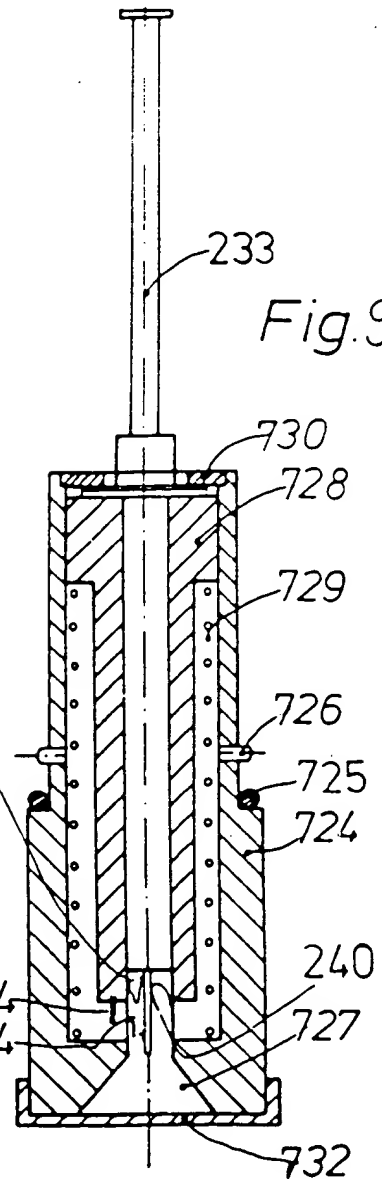


Fig. 9

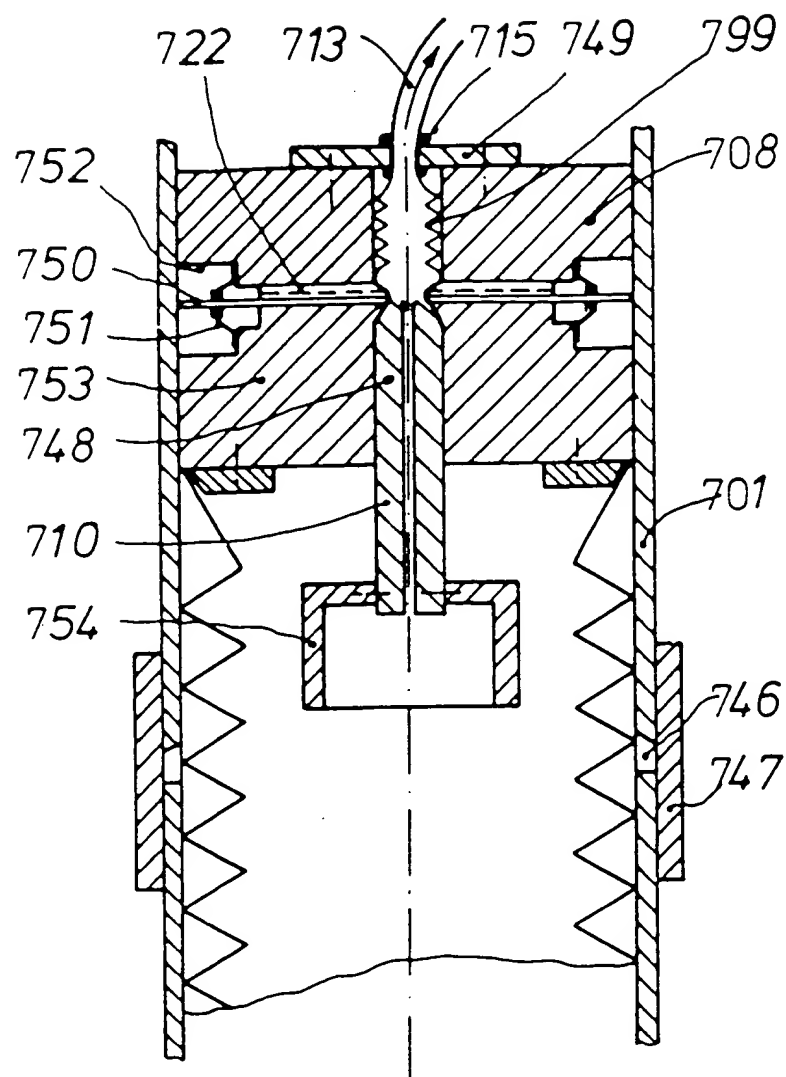


Fig. 11

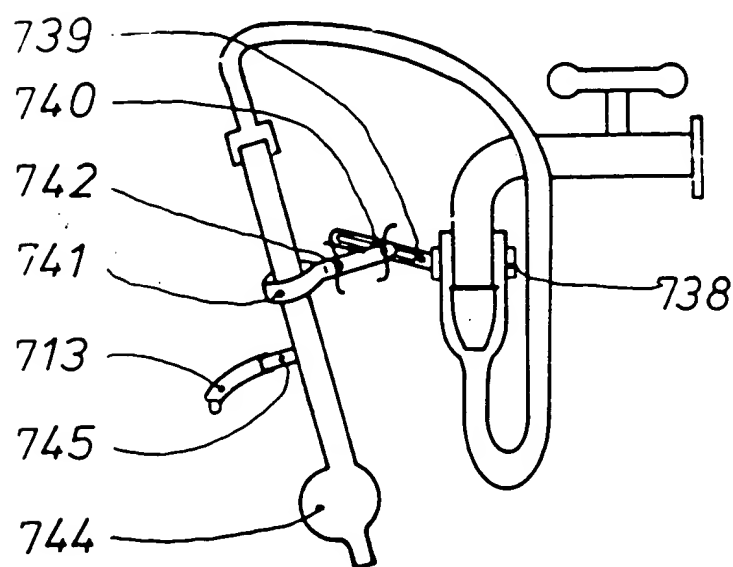
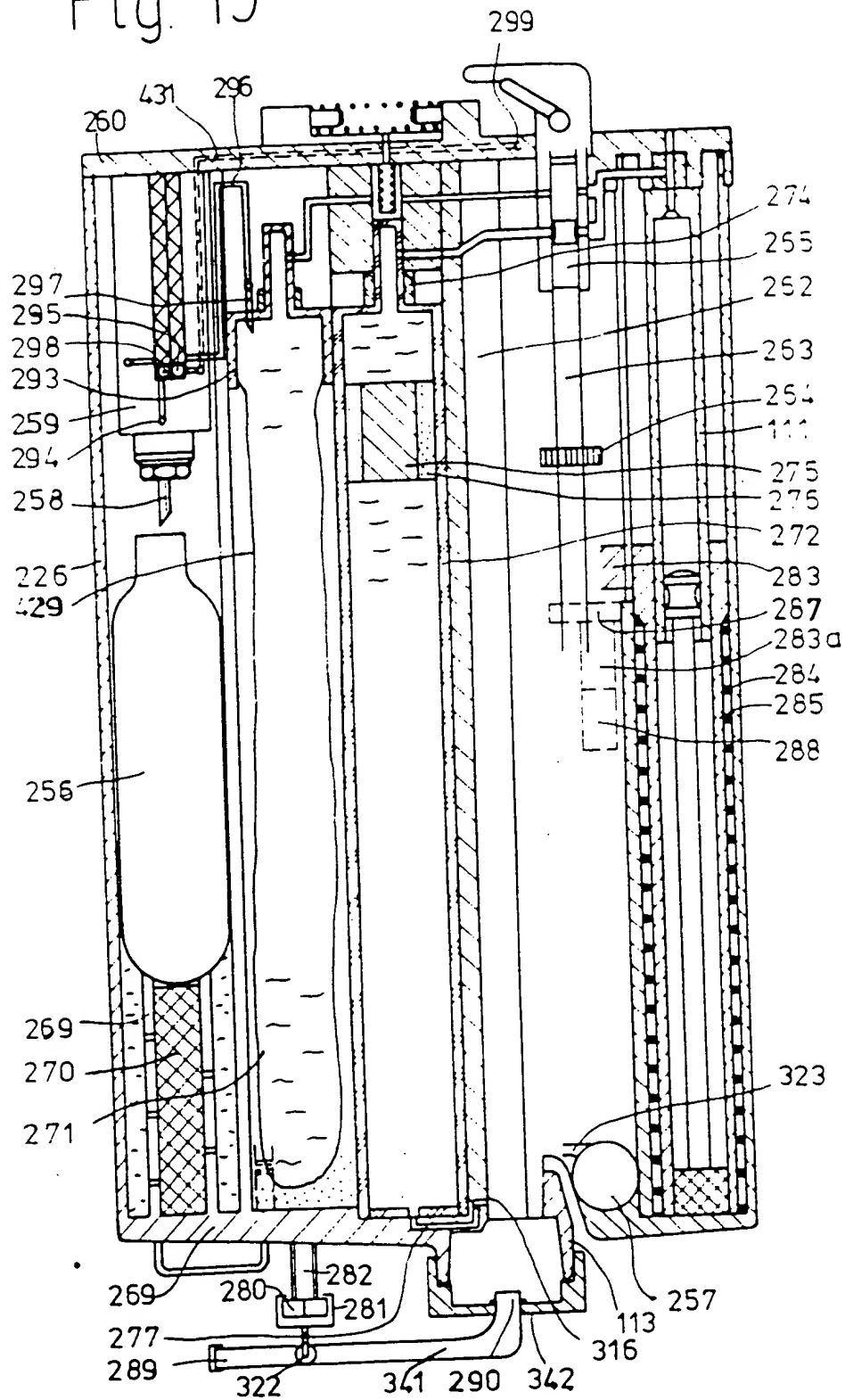


Fig. 12

Fig. 13



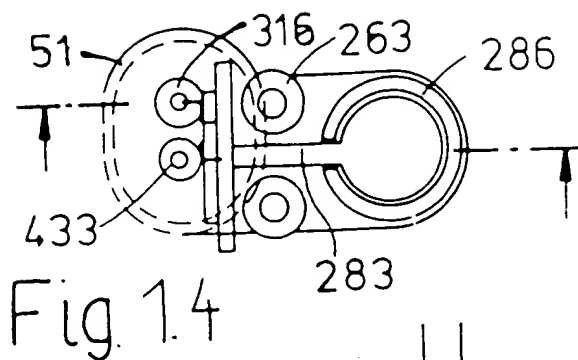


Fig. 14

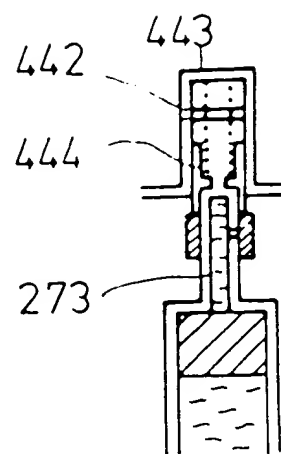


Fig. 16

Fig. 17

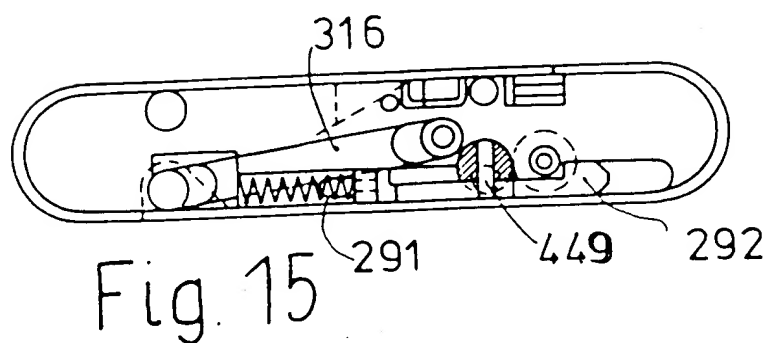
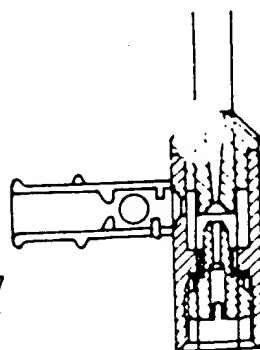


Fig. 15

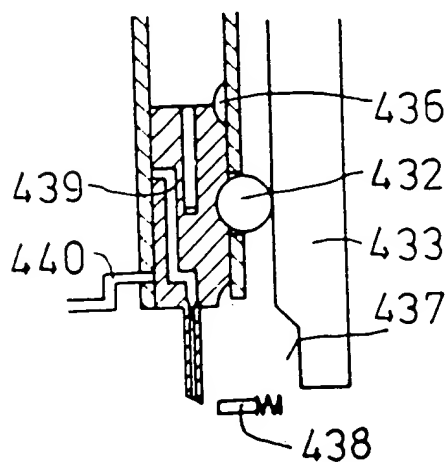
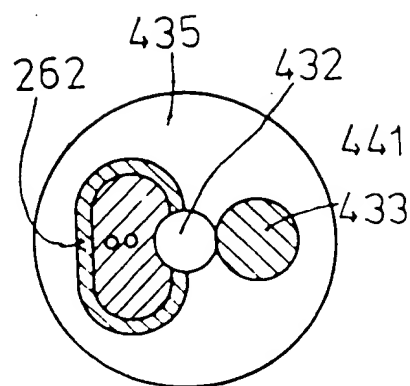


Fig. 18



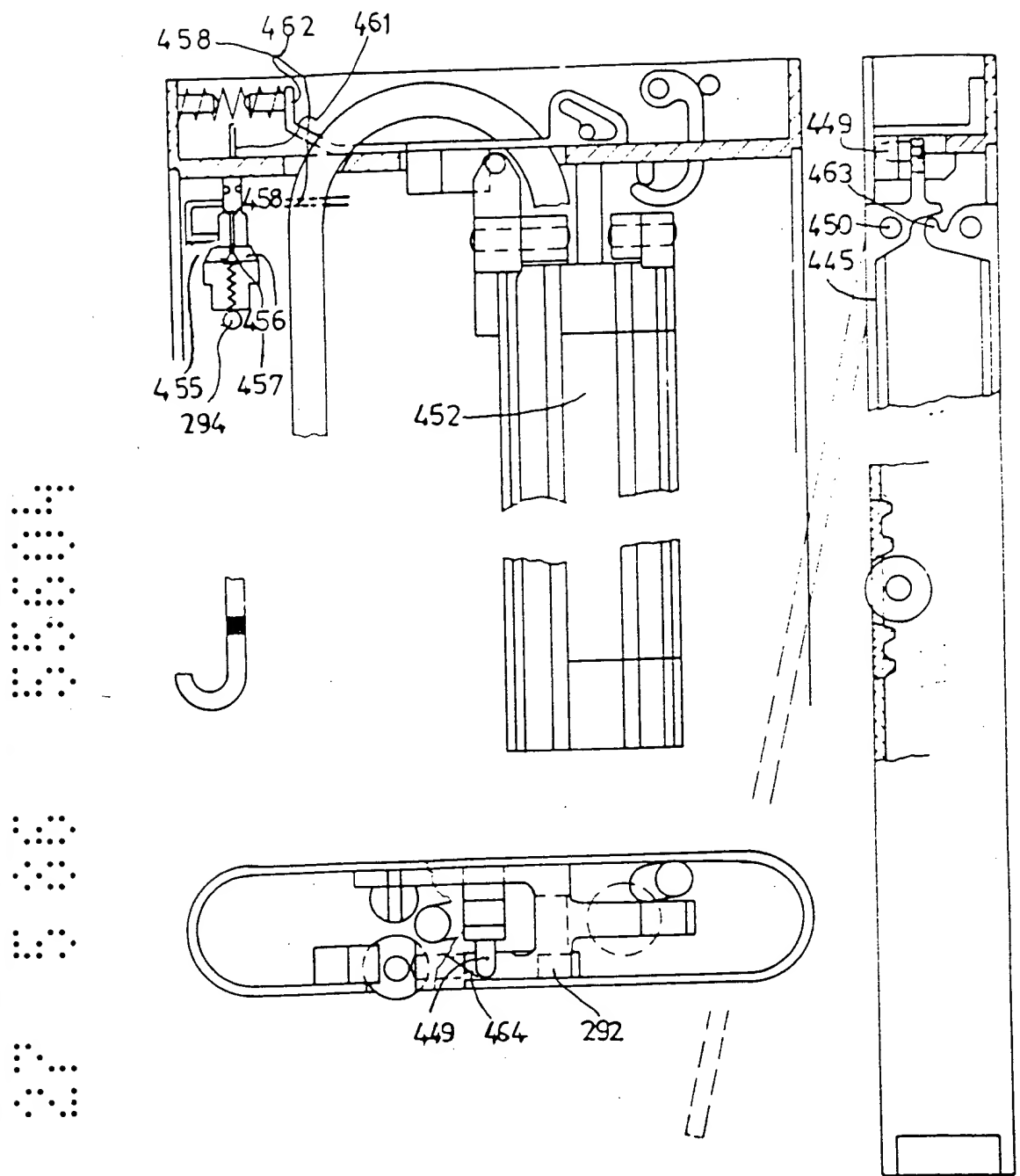


Fig. 19

Fig. 20

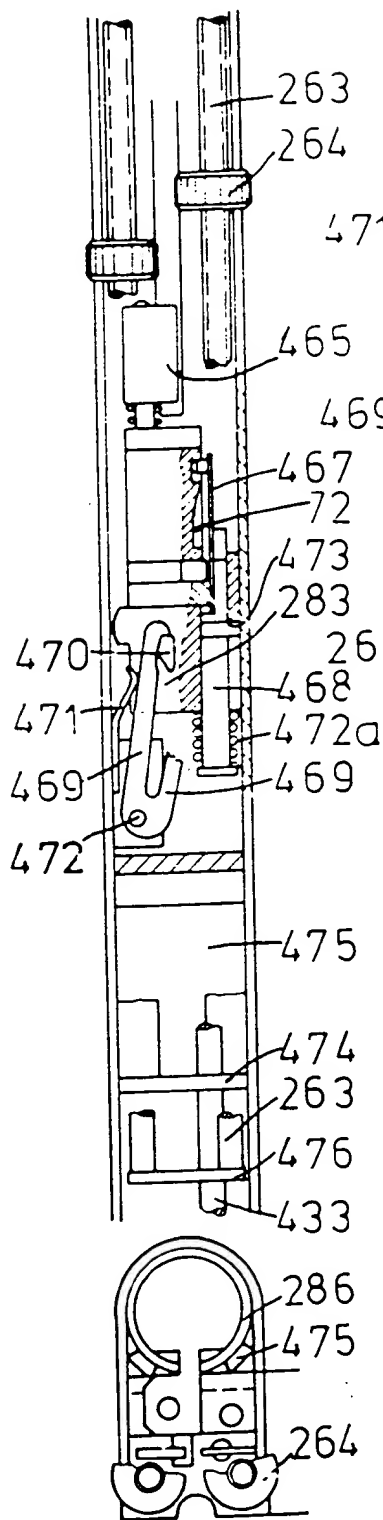
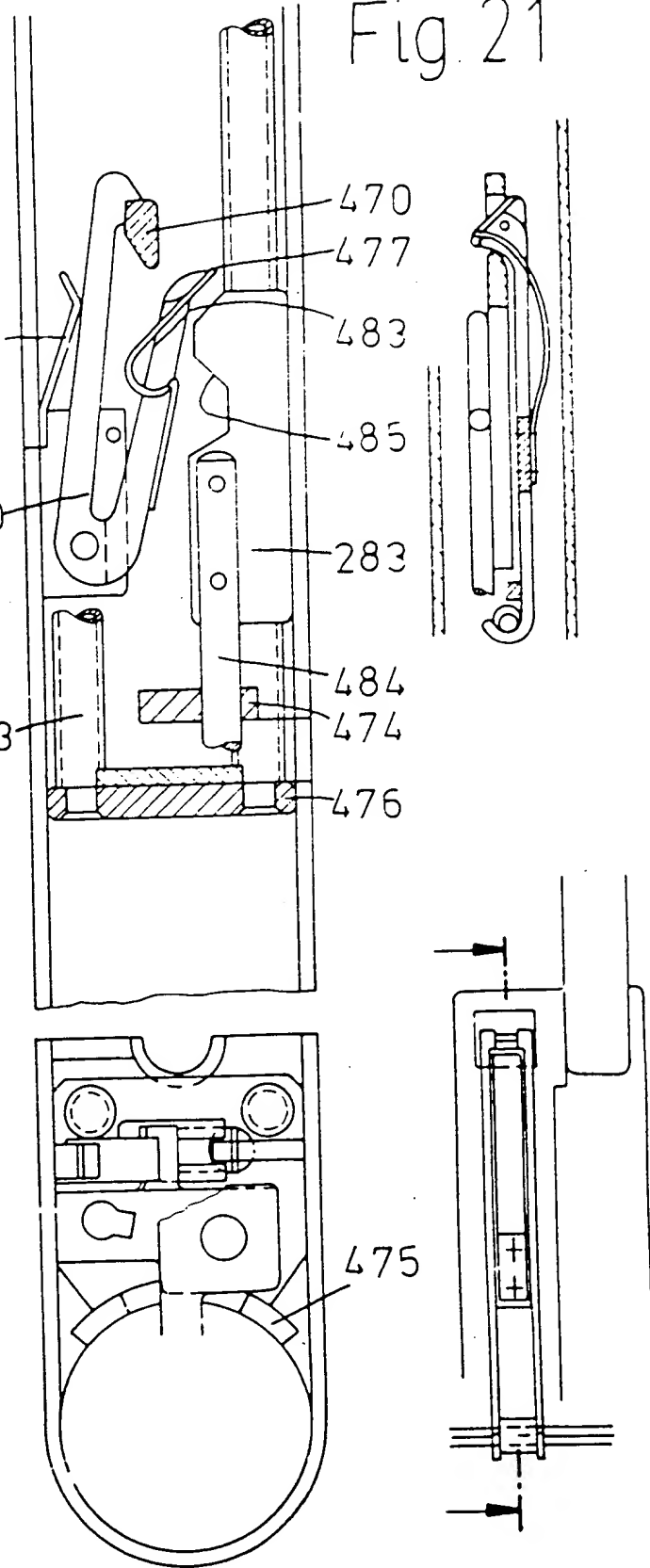
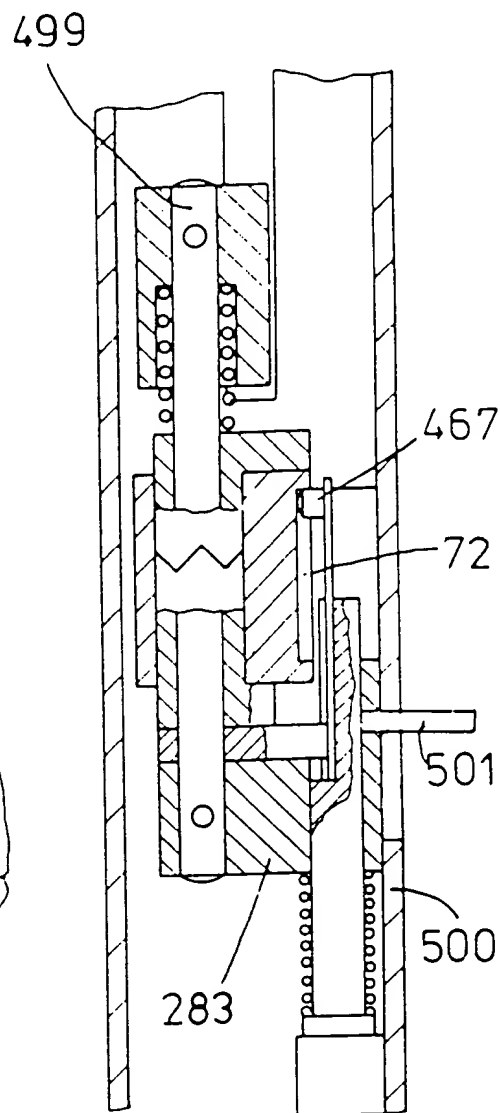
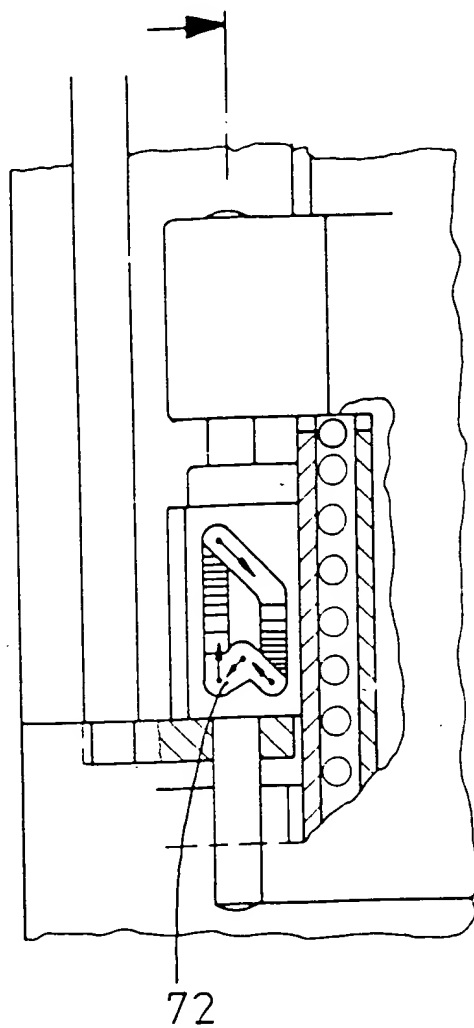
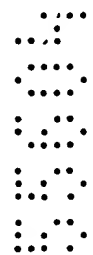
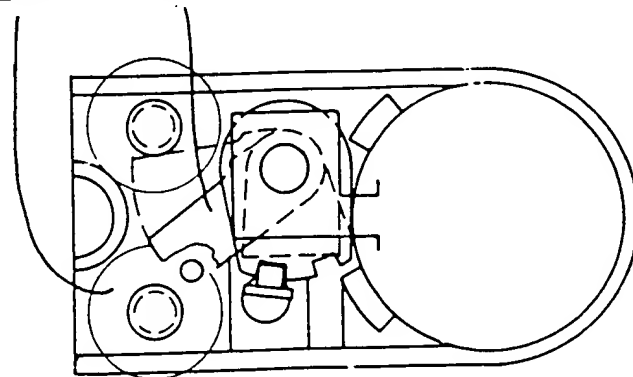


Fig. 21





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Fig. 22

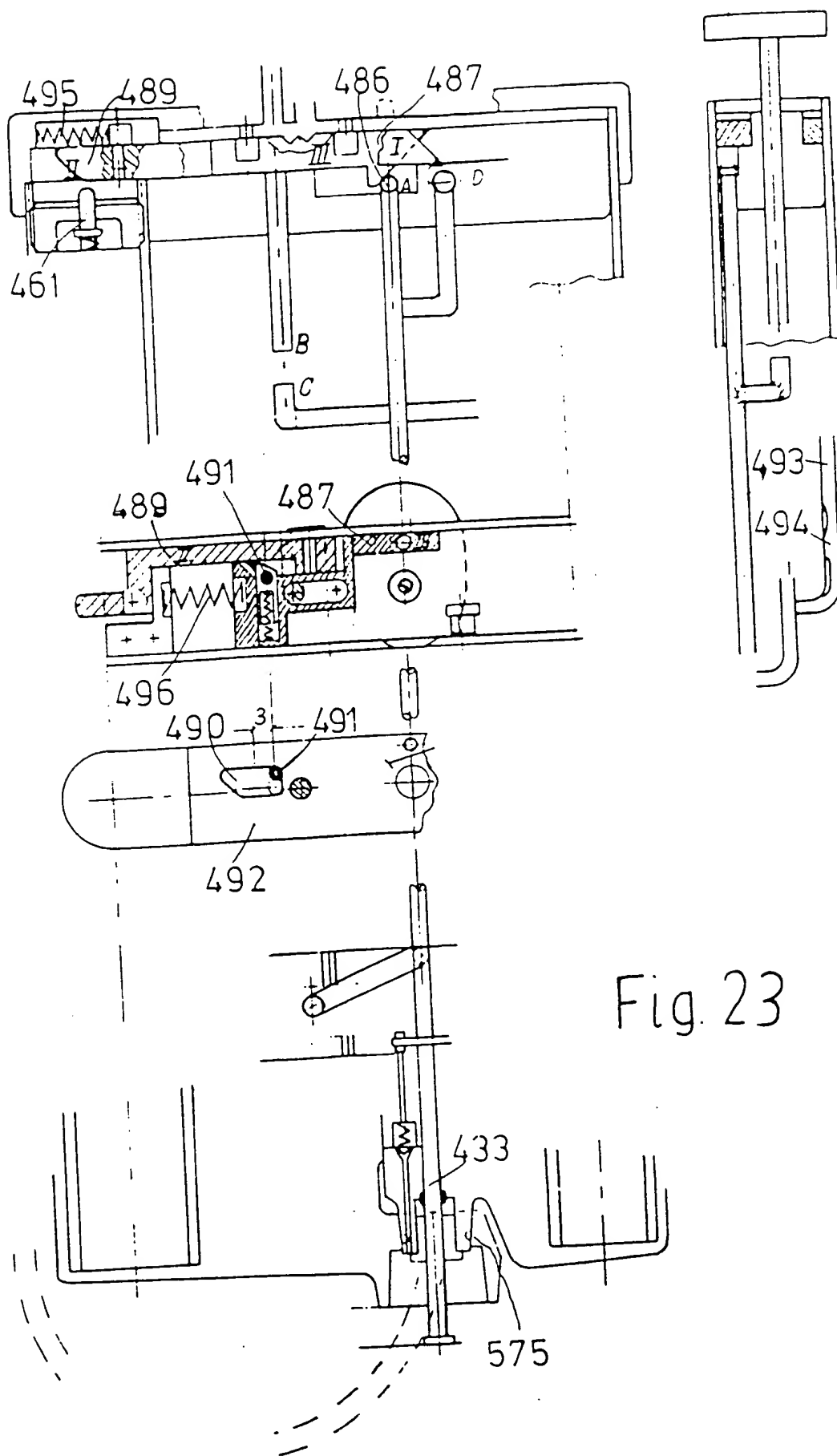


Fig. 23

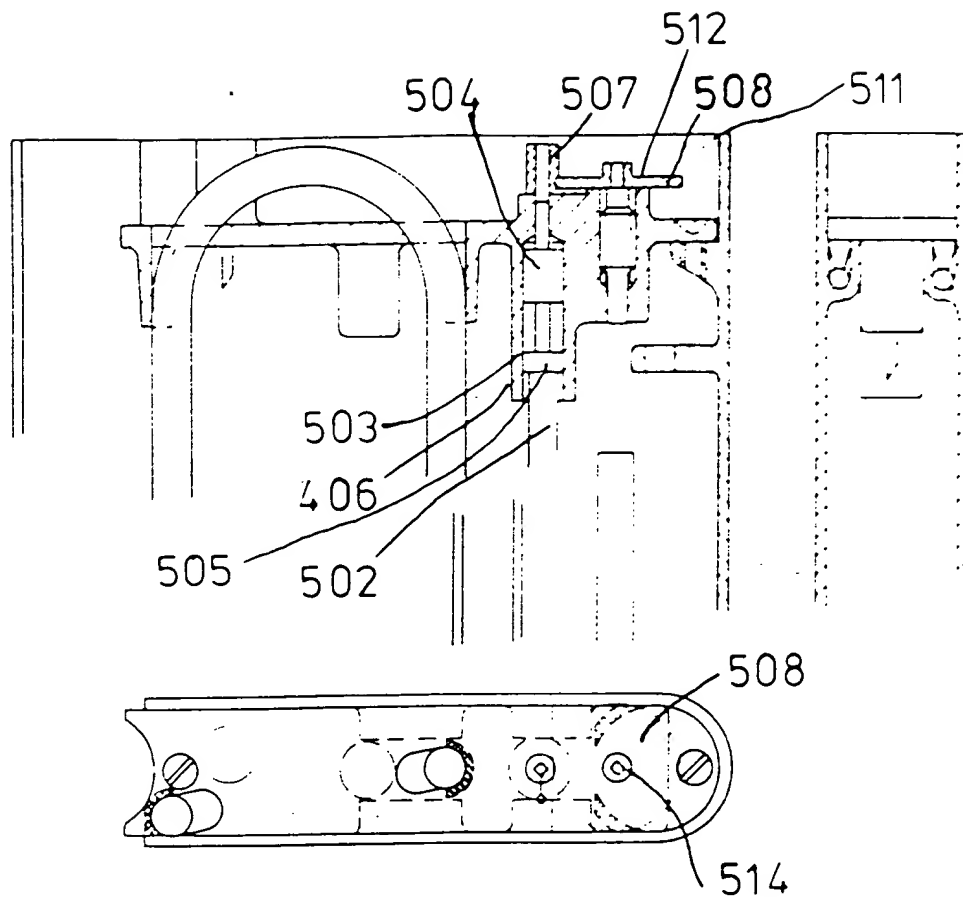


Fig. 24

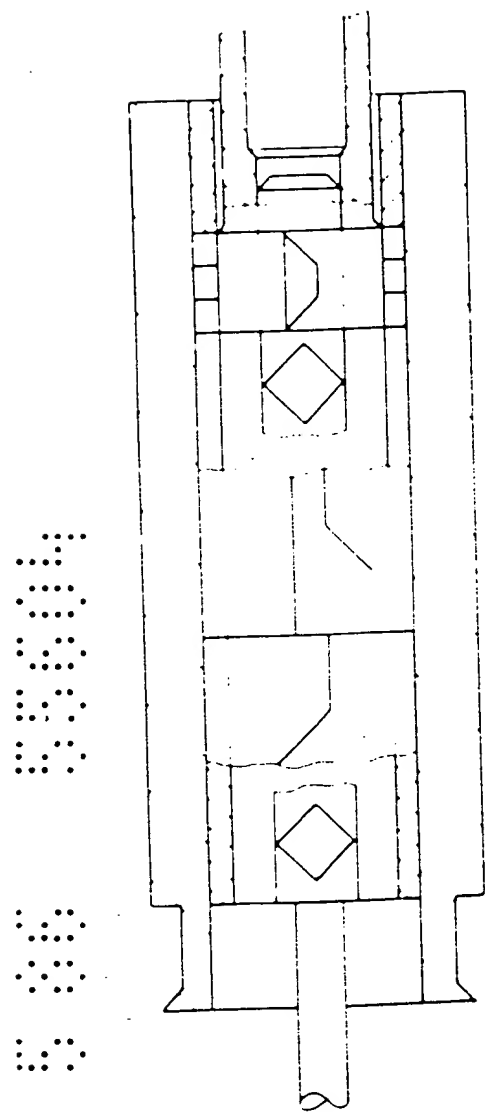


Fig. 25

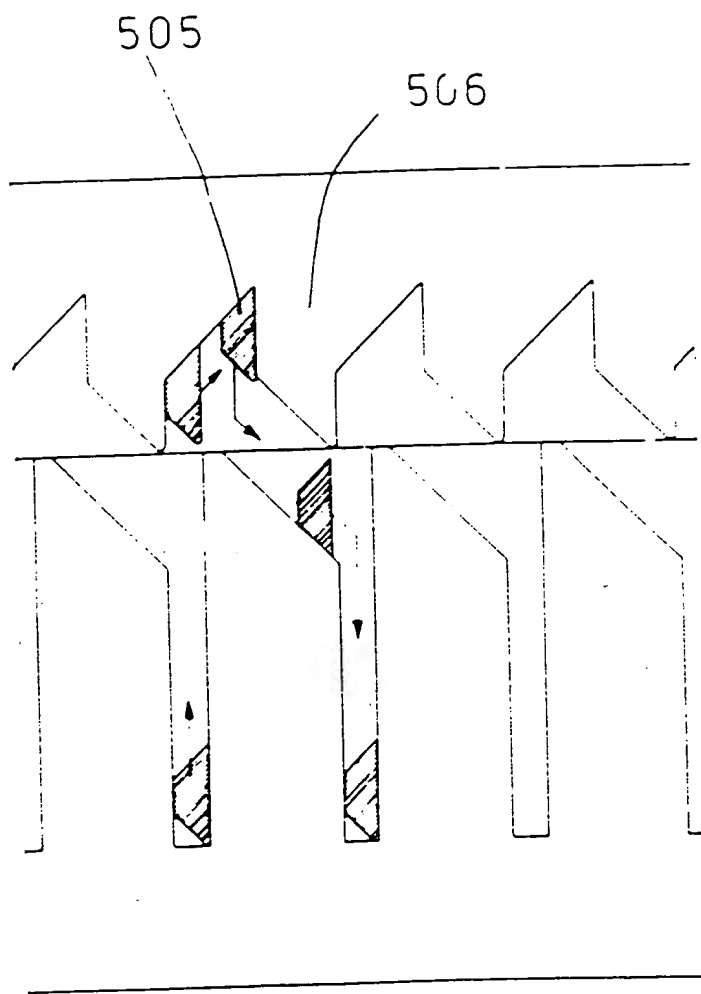
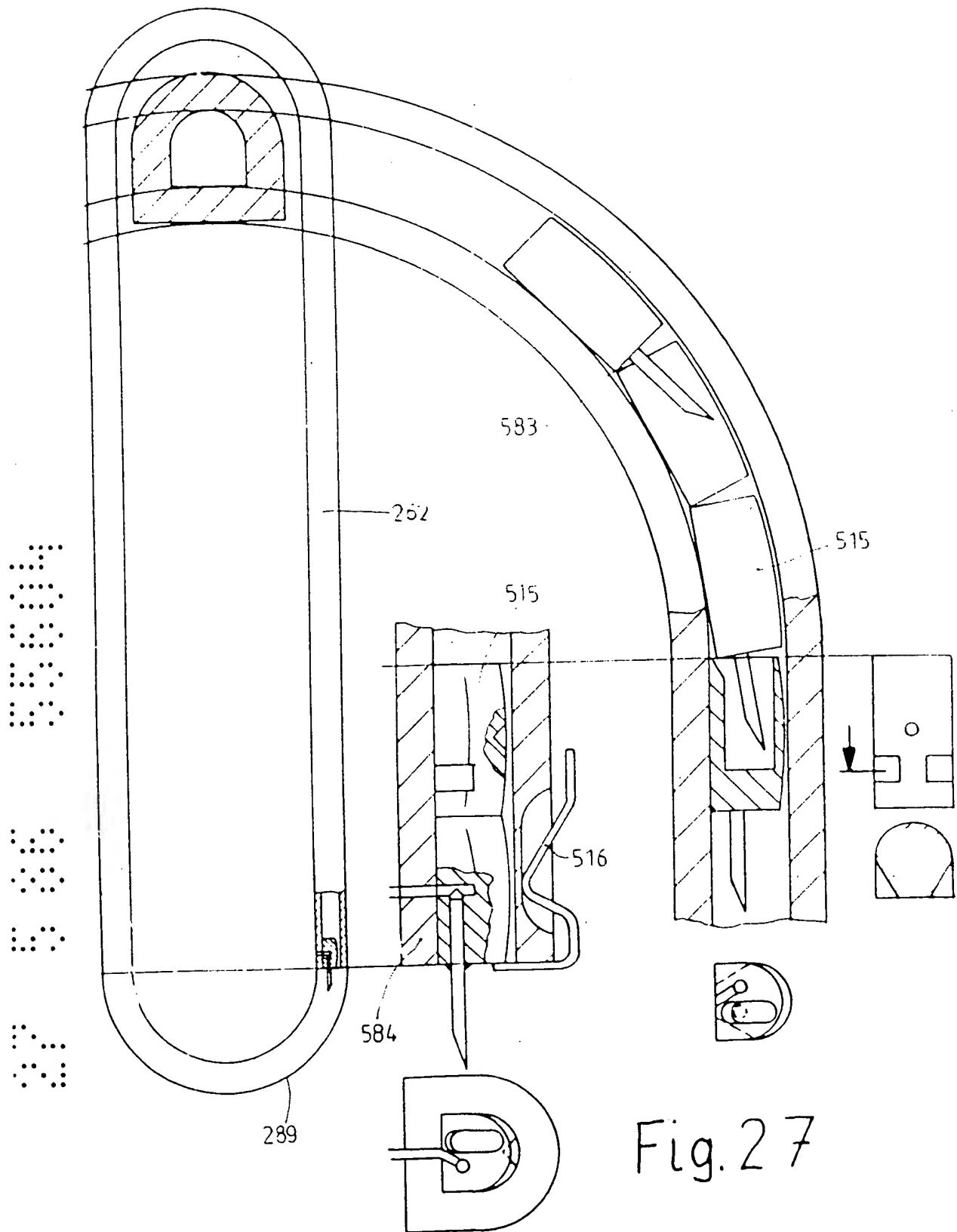
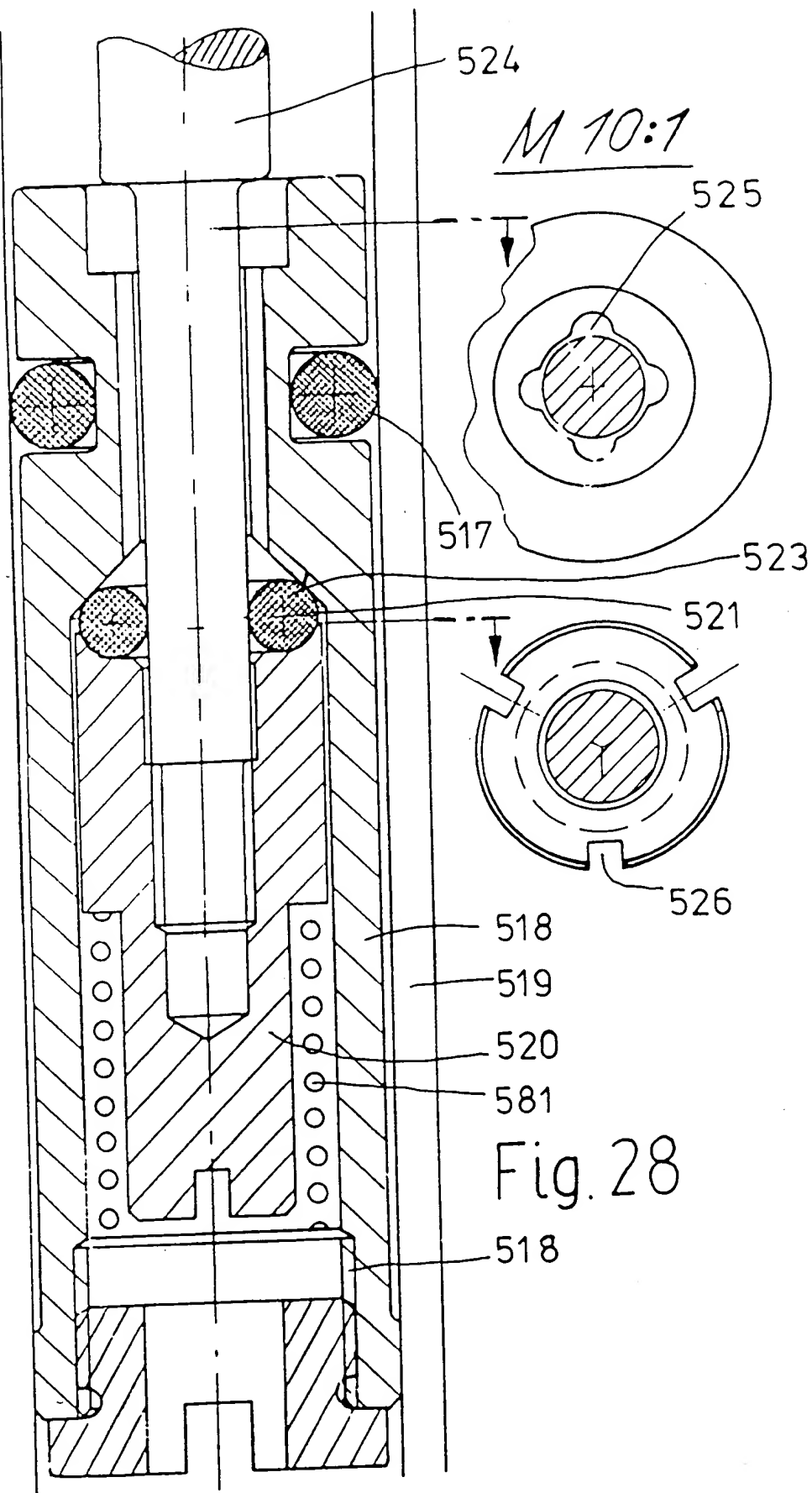


Fig. 26





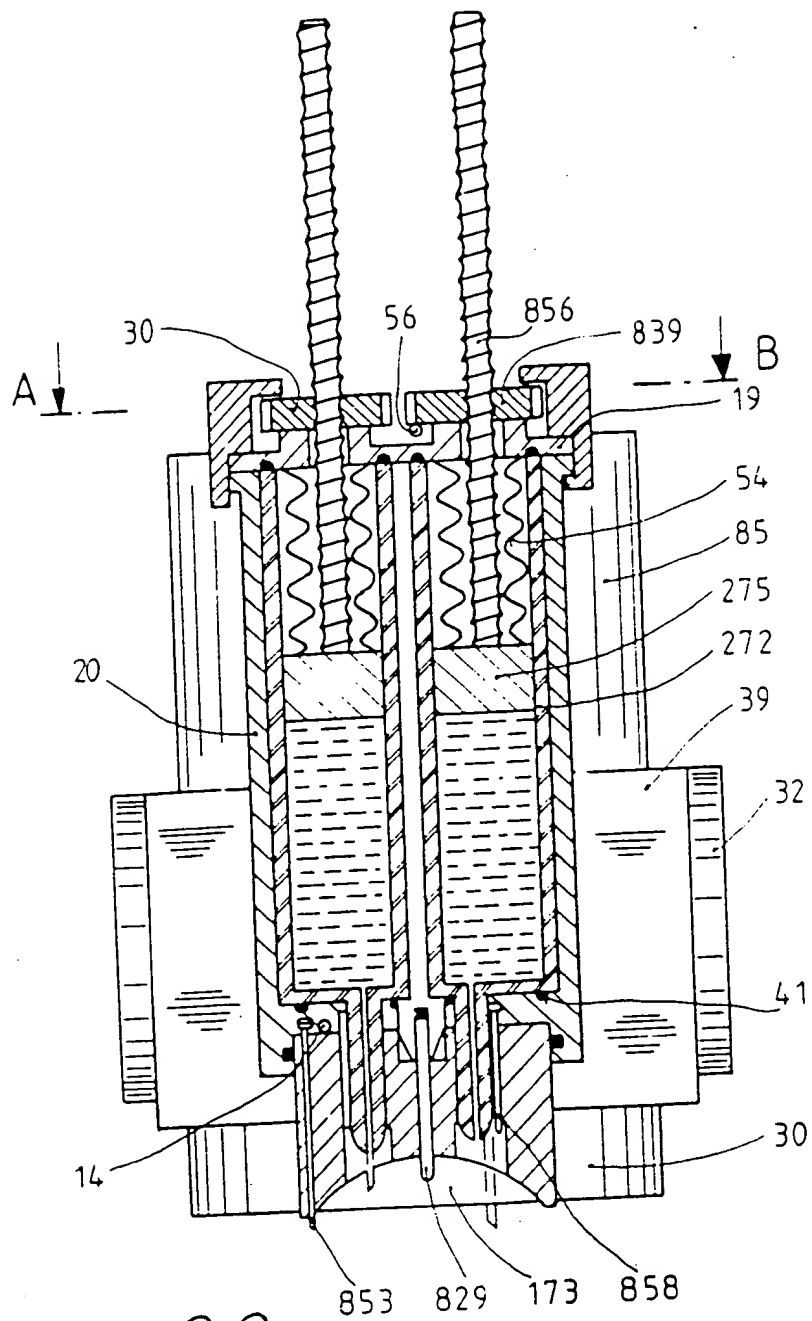
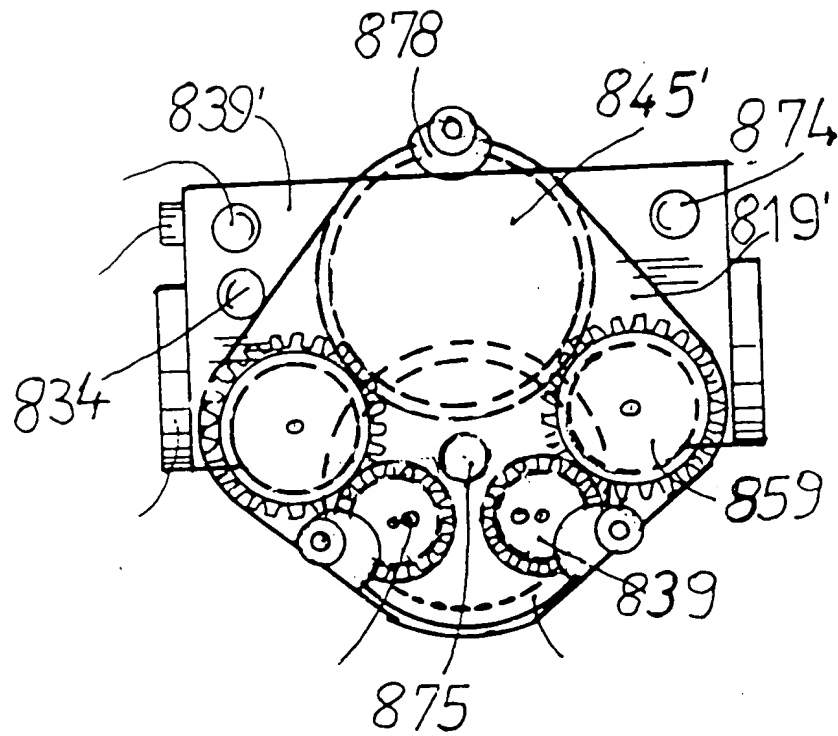
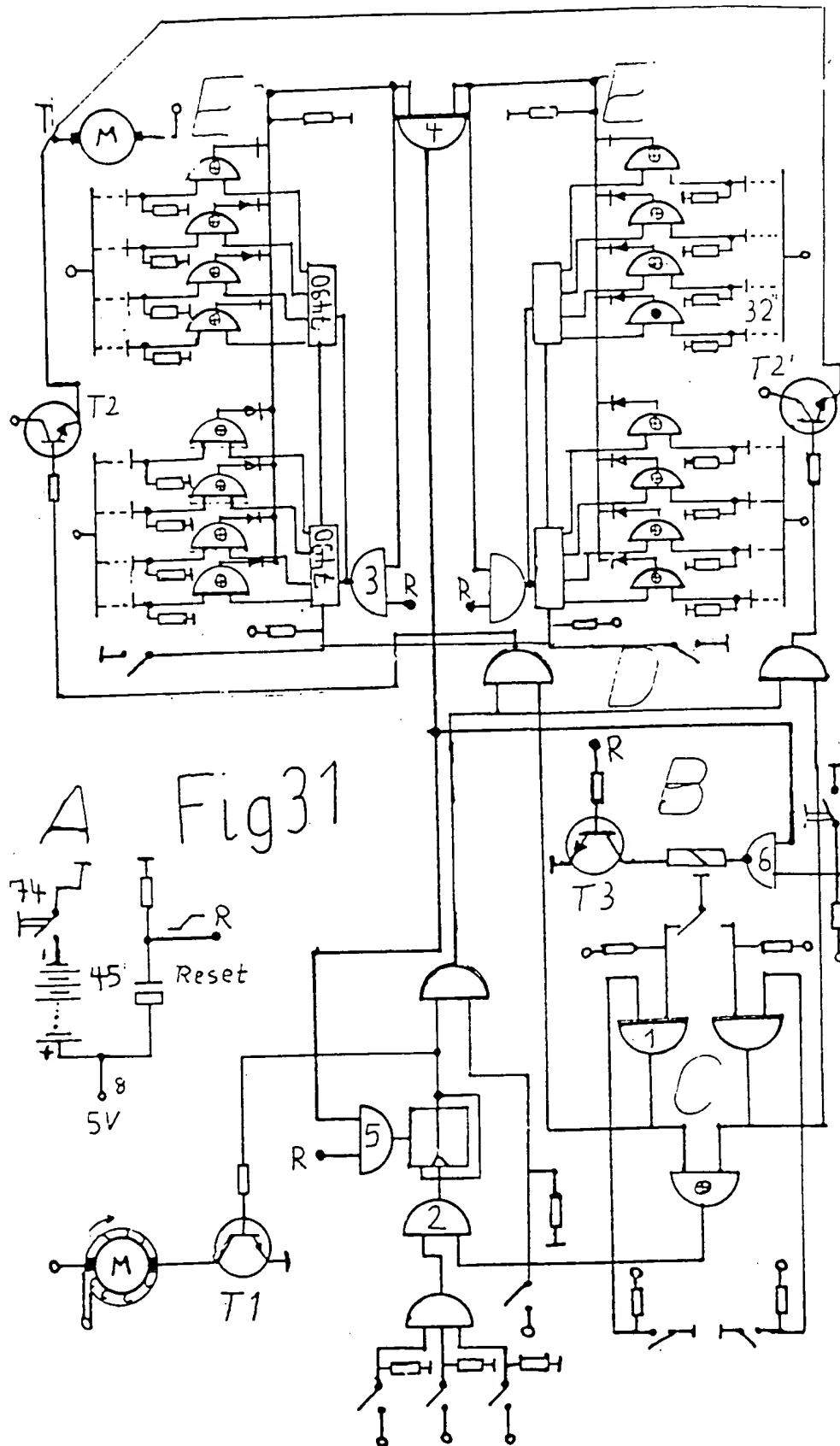
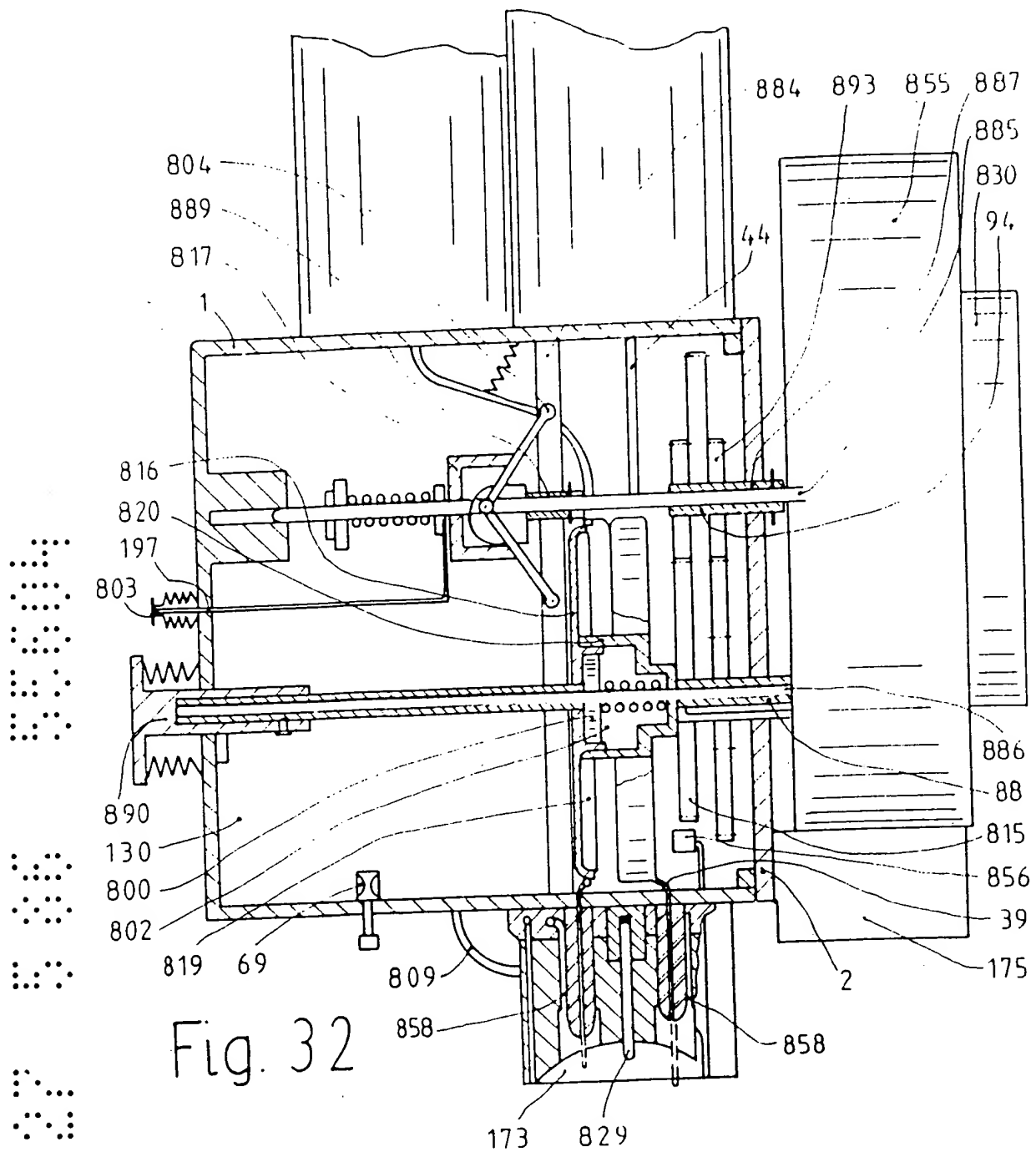


Fig.29

Fig. 30.







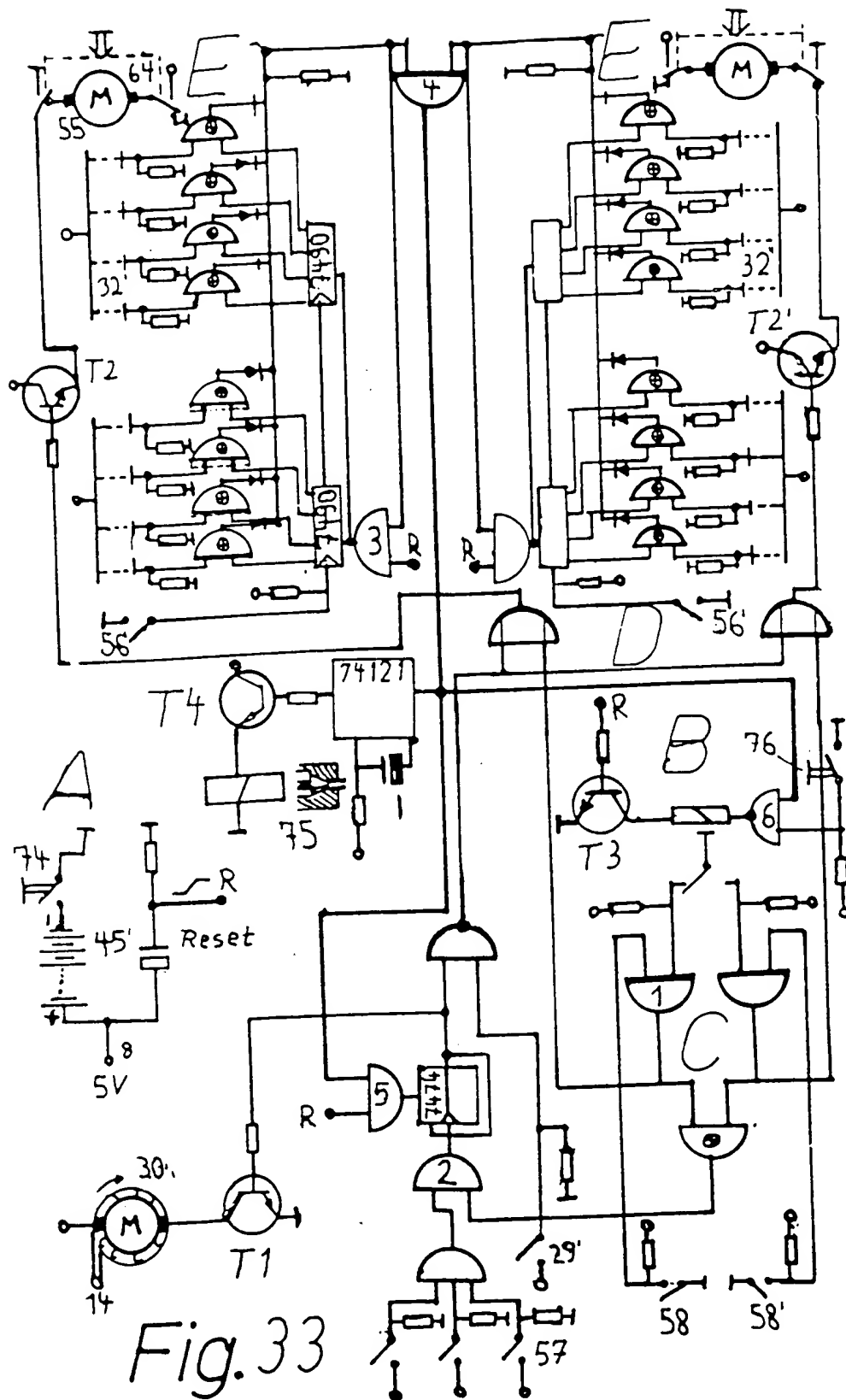


Fig. 33

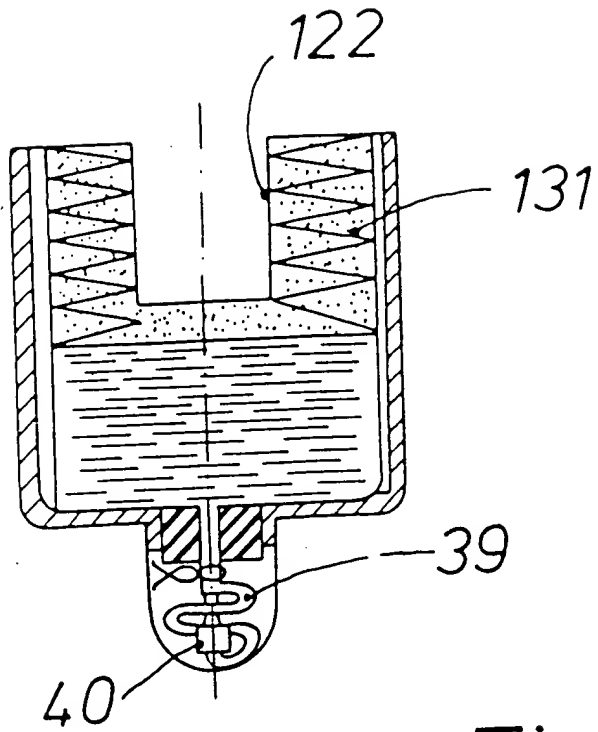


Fig. 34

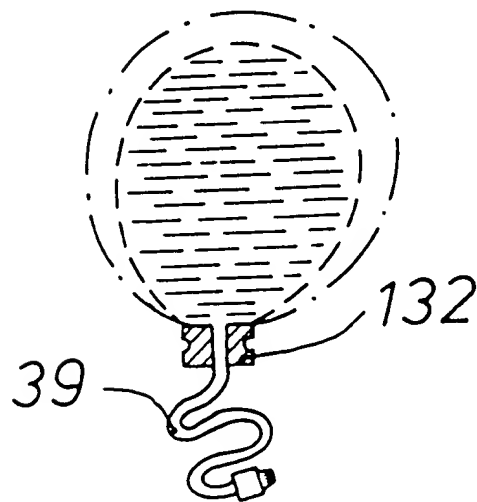


Fig. 35

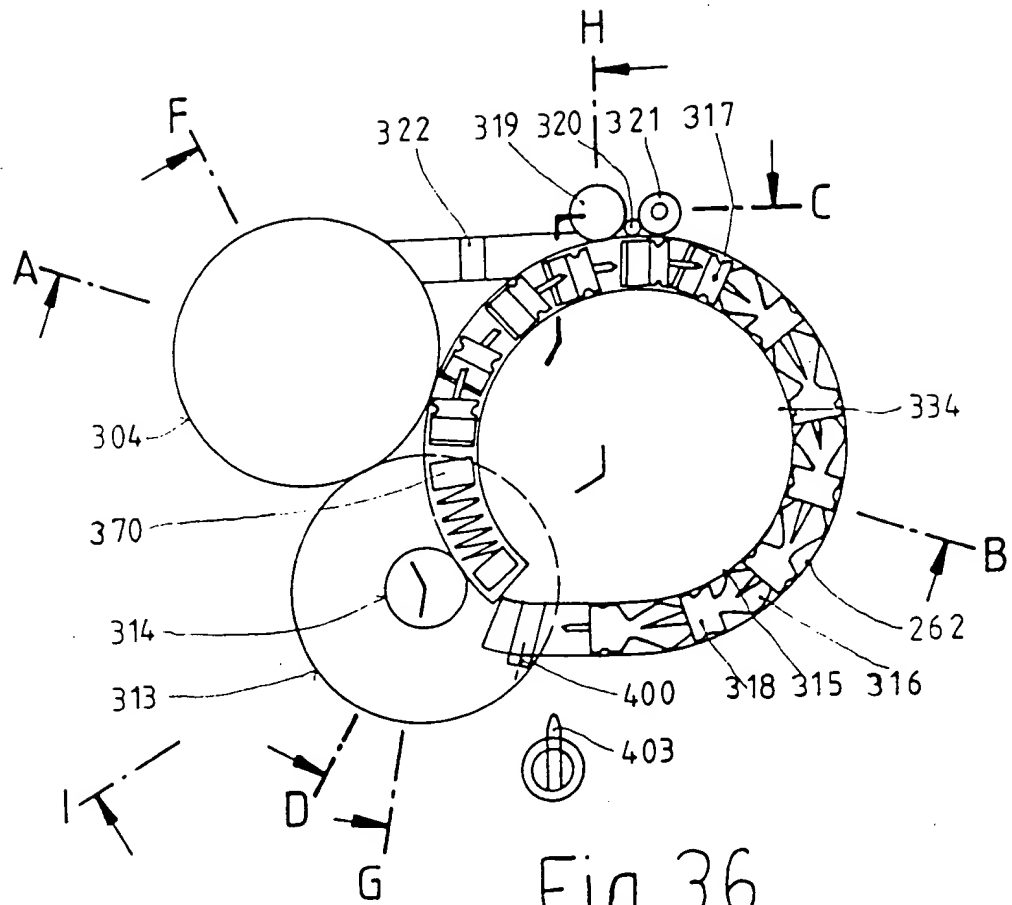
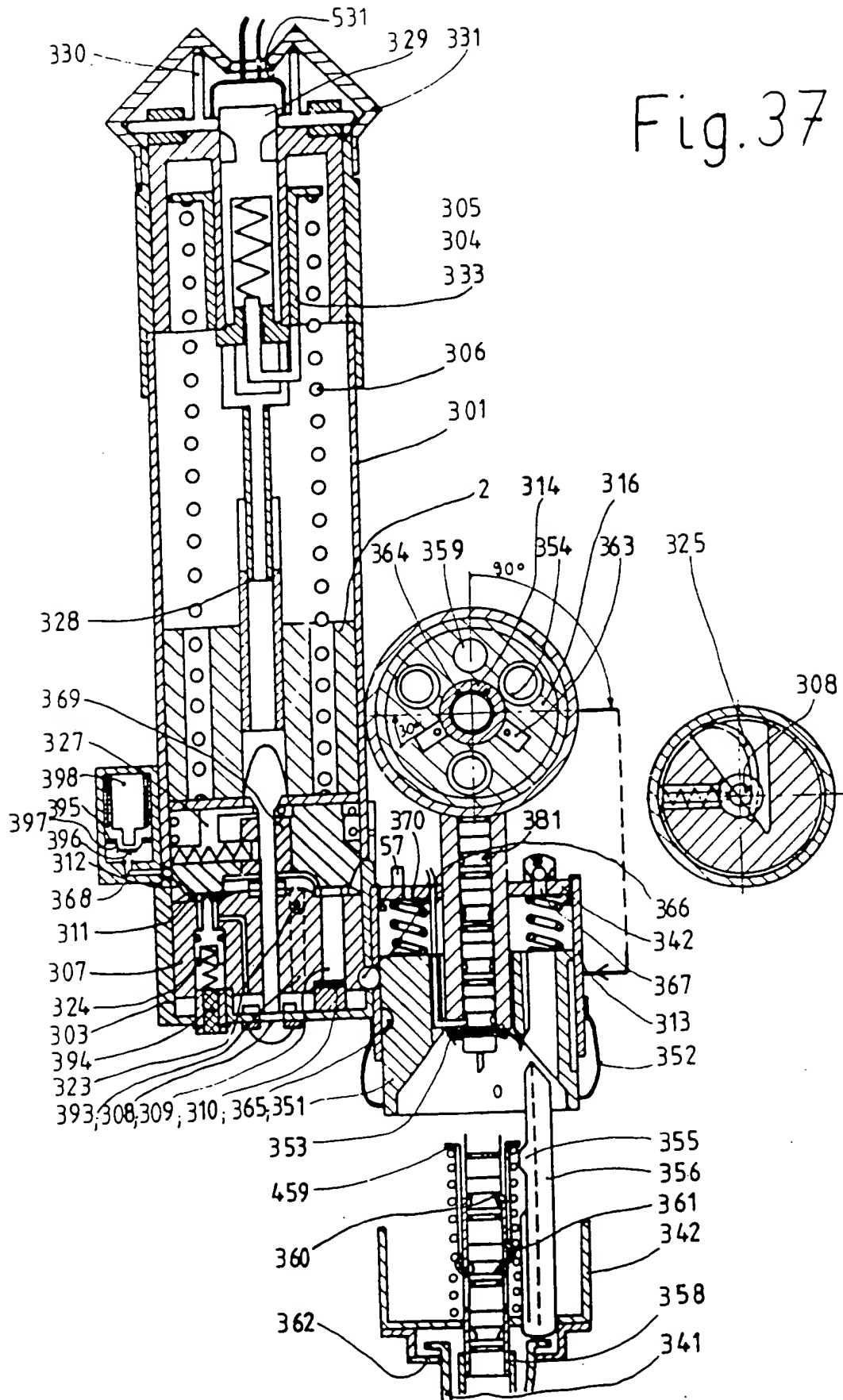


Fig. 36

Fig. 37



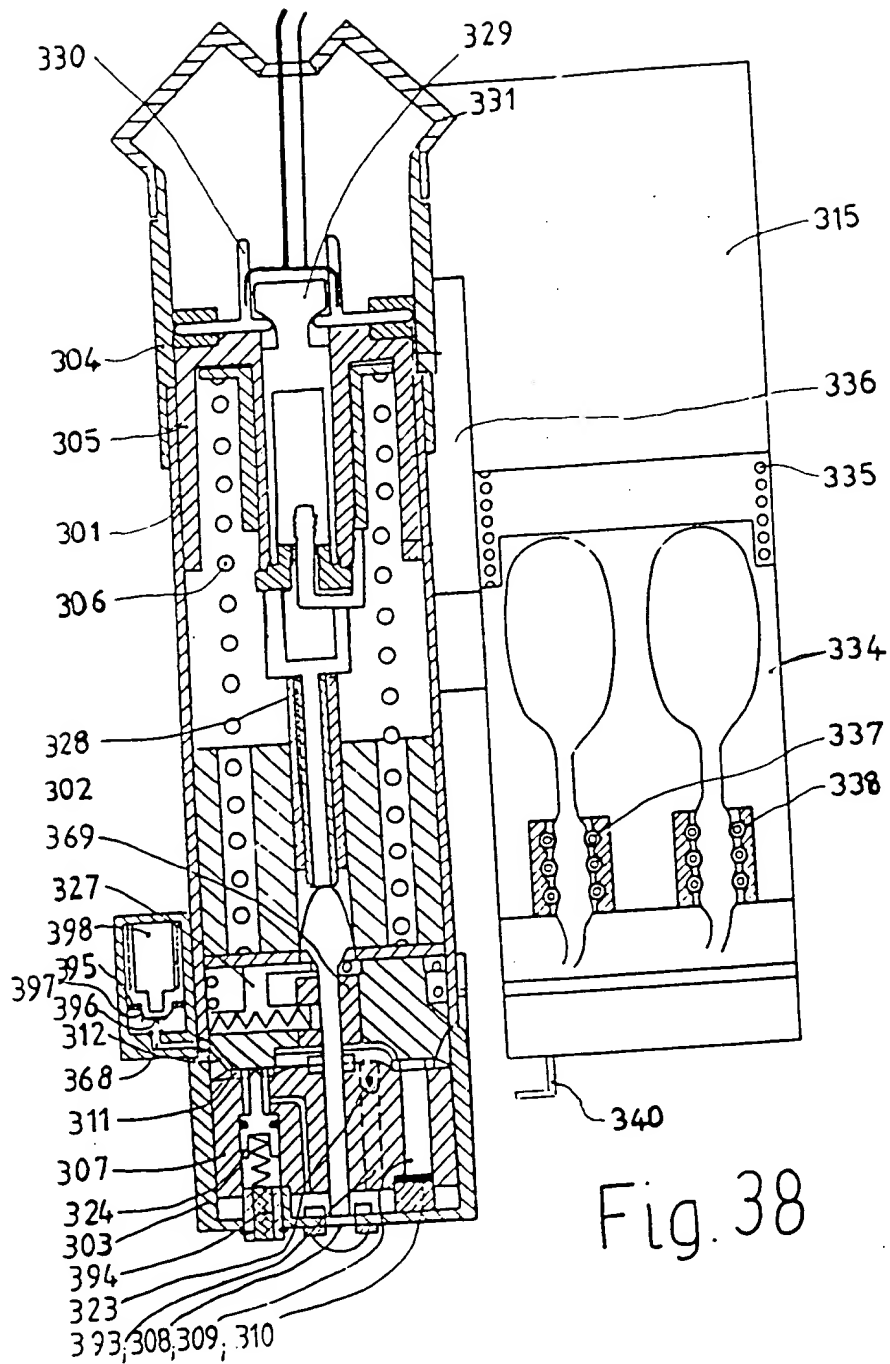
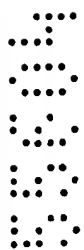
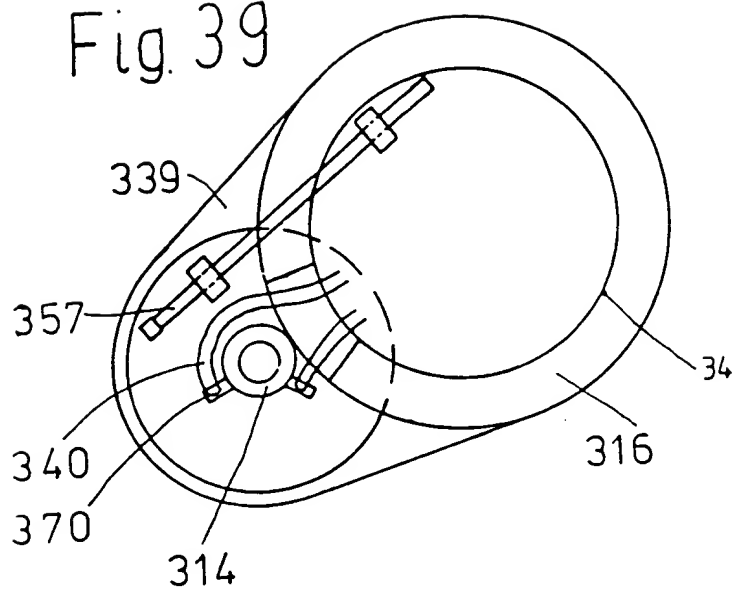
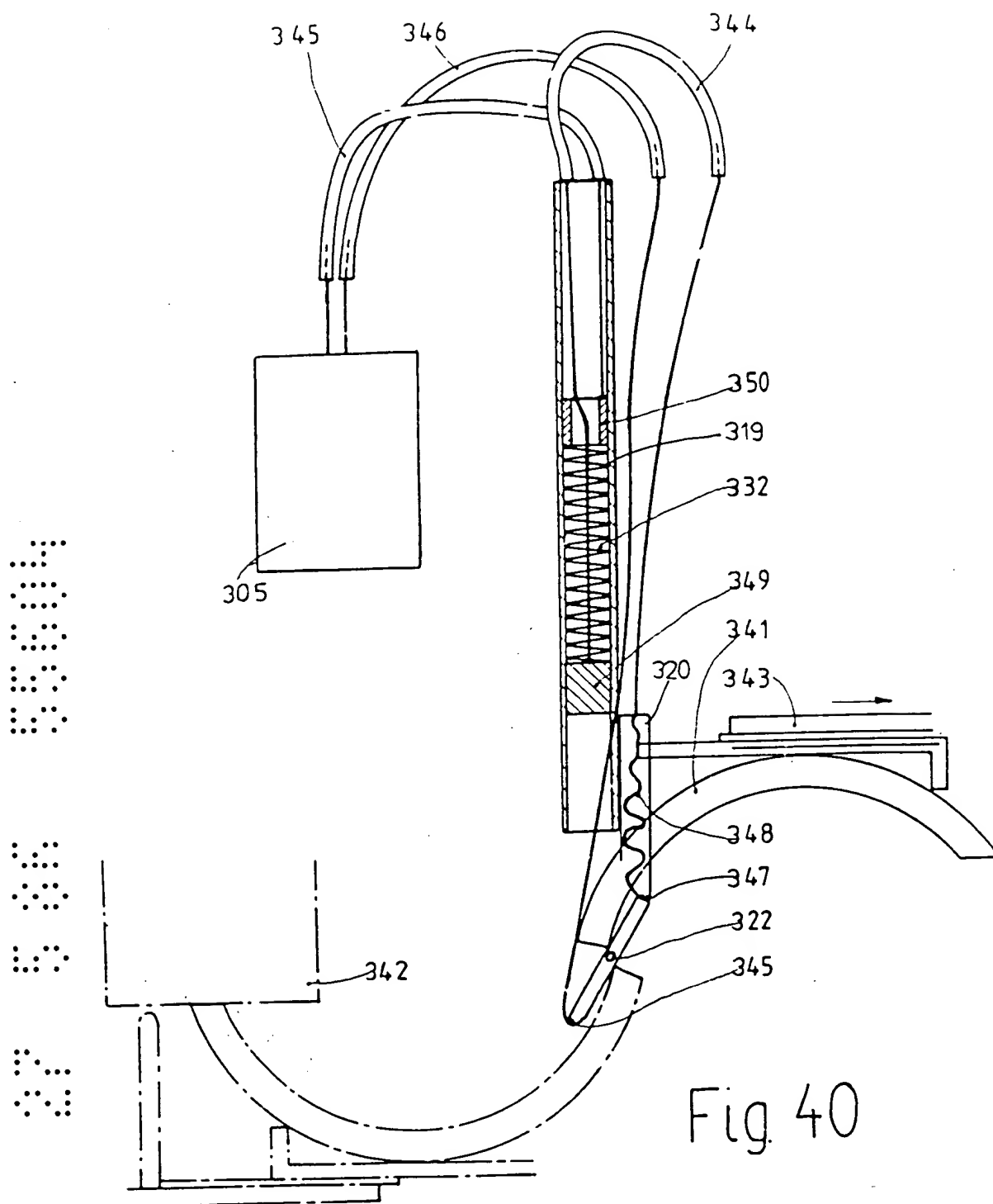


Fig. 39





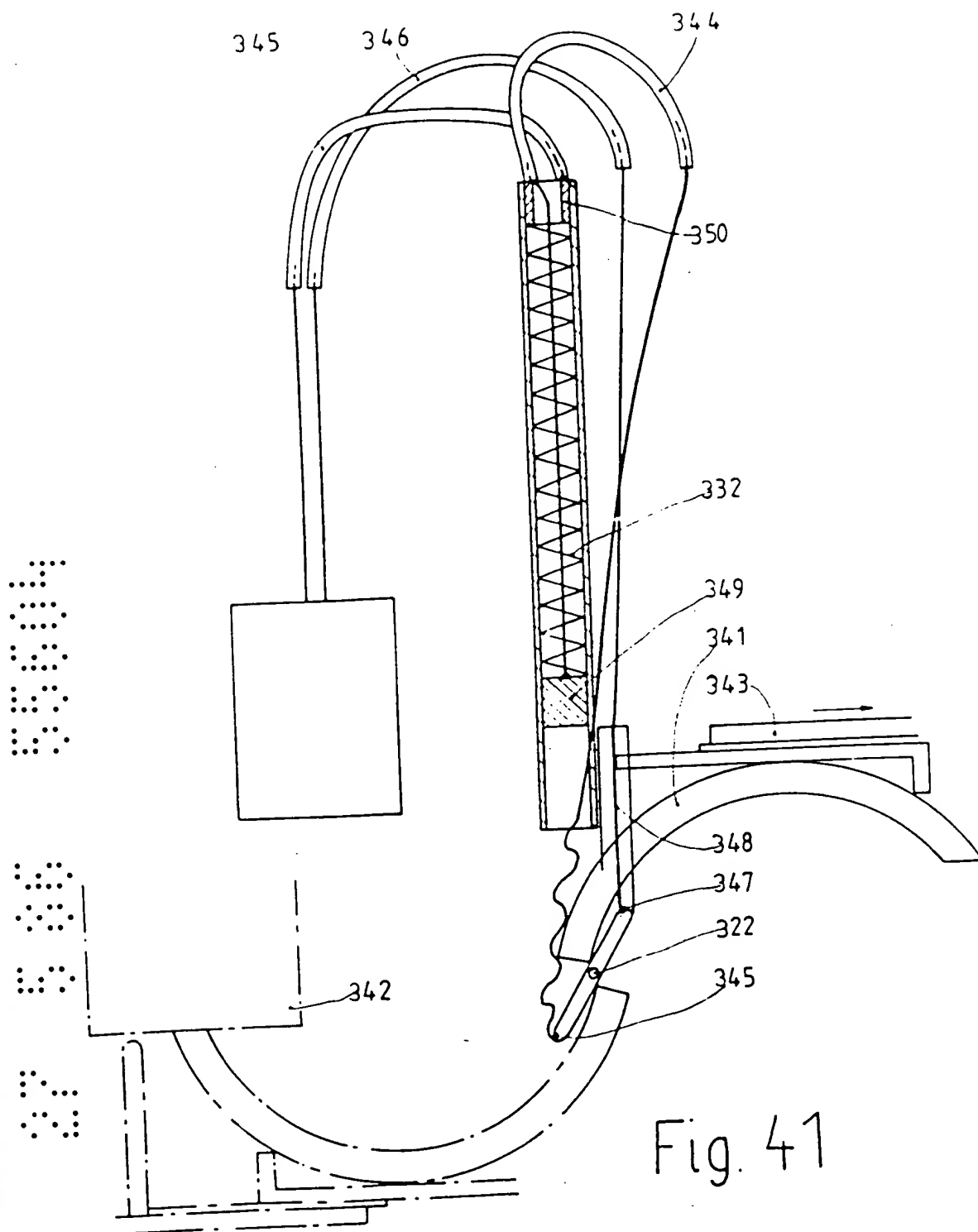


Fig. 41

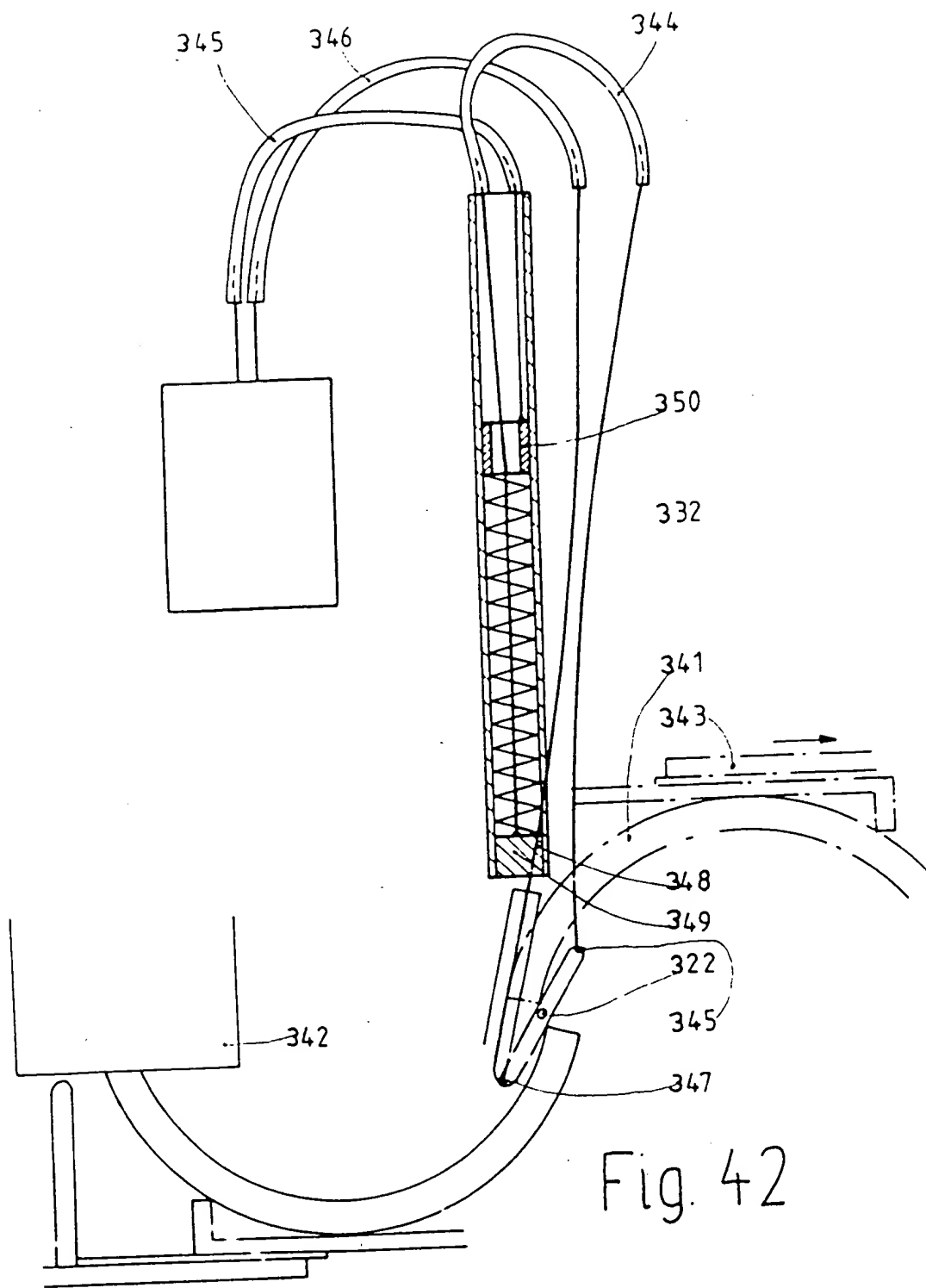


Fig. 42

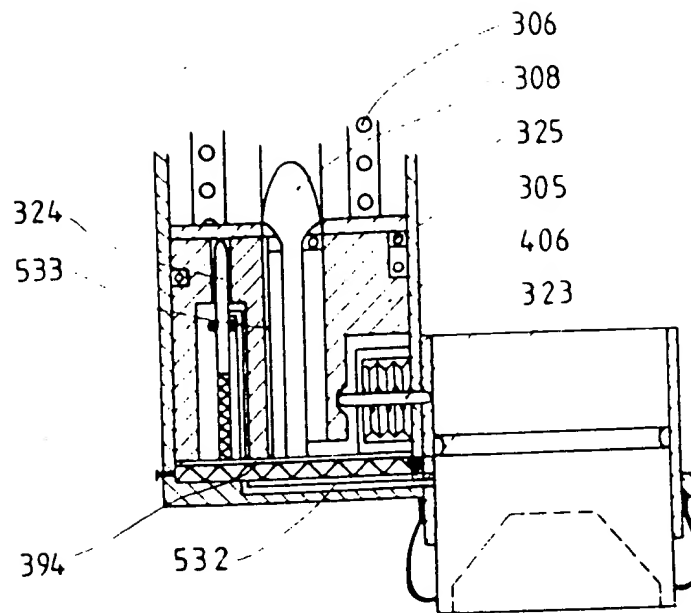


Fig. 43

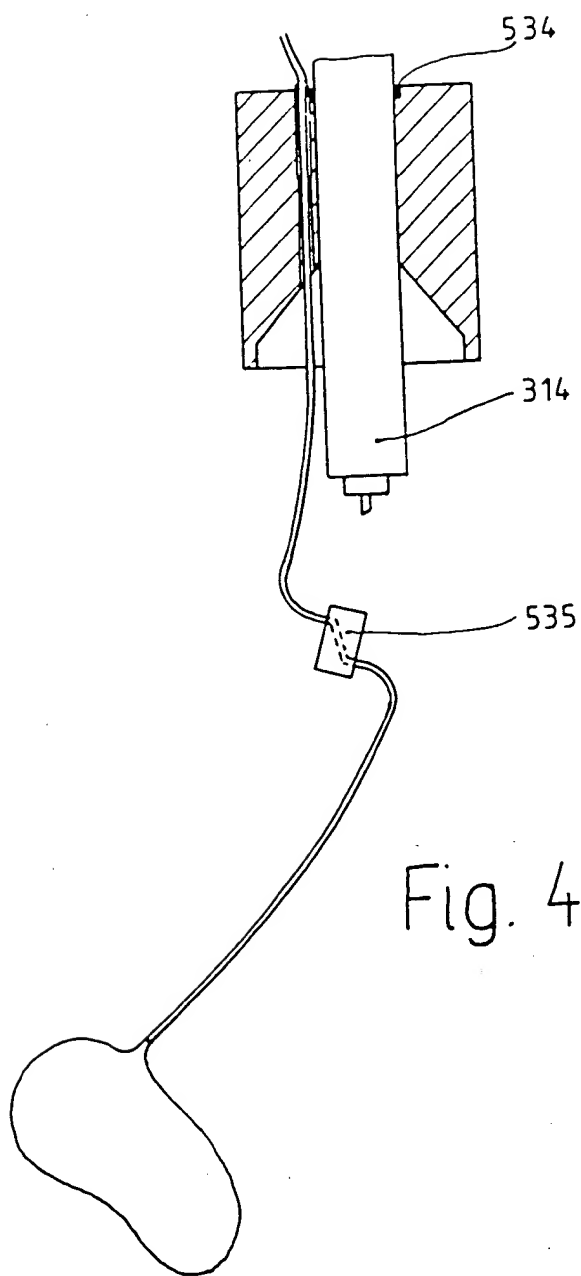
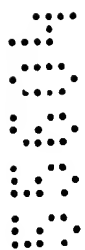


Fig. 44

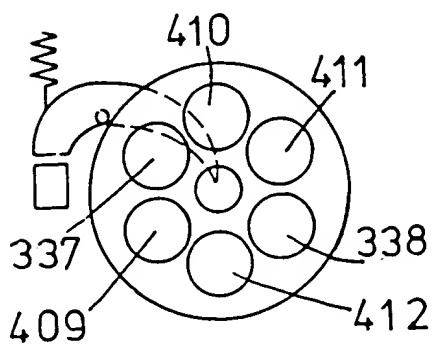
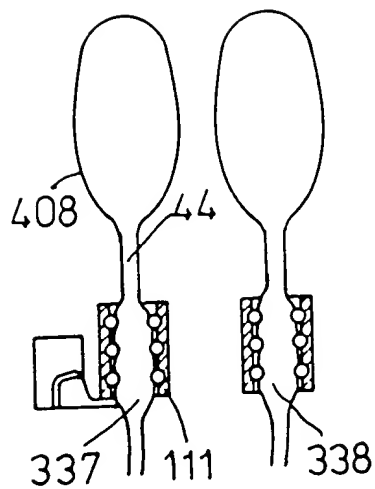


Fig. 45

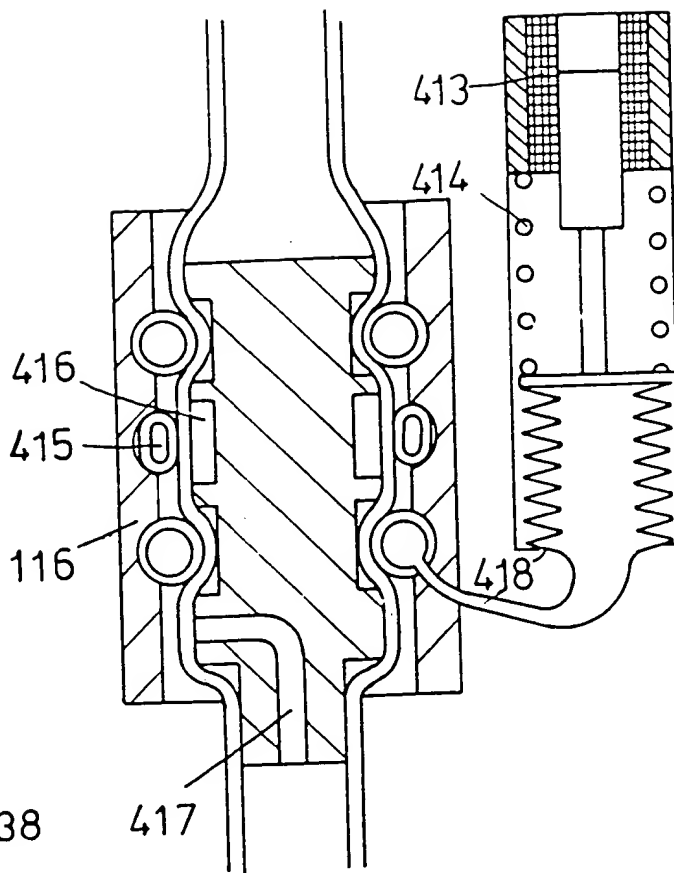


Fig. 46

Fig. 47

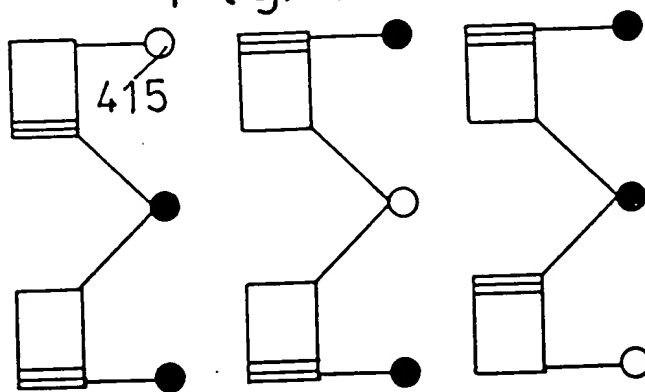


Fig. 48

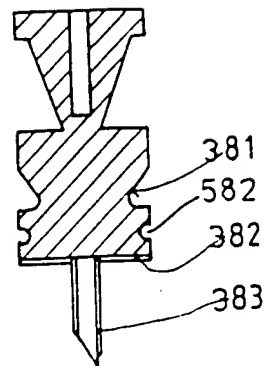
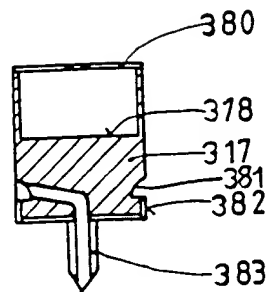


Fig. 49



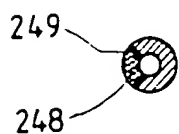
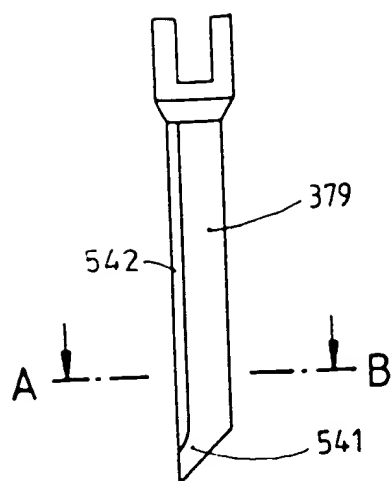


Fig. 50

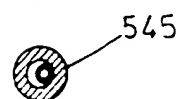
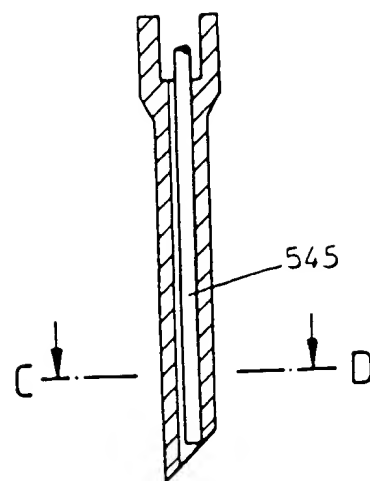


Fig. 51

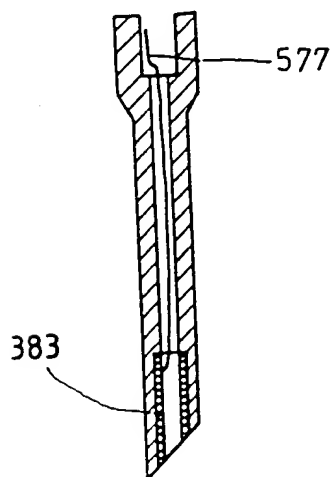


Fig. 52

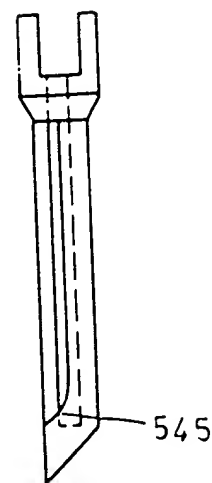
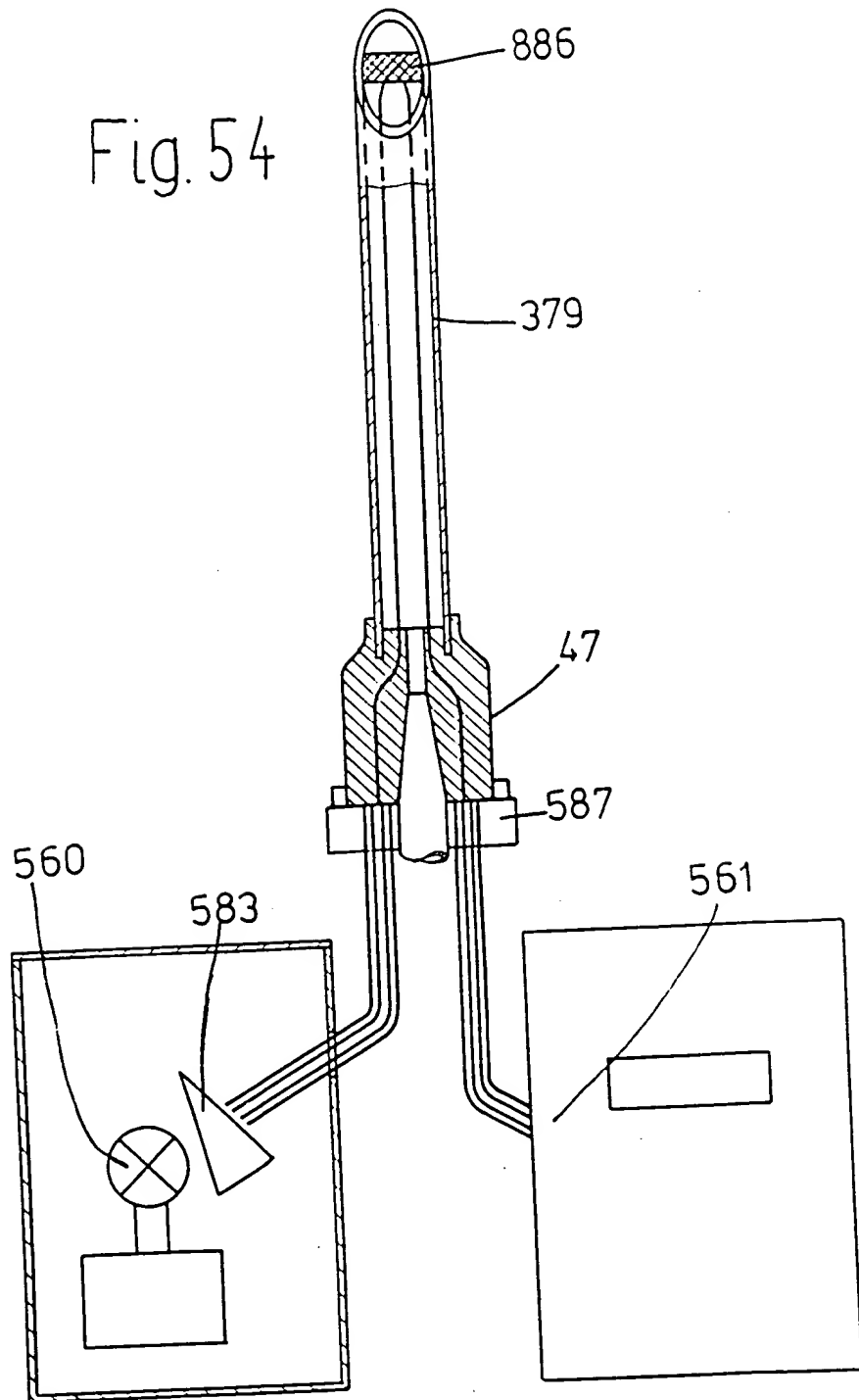
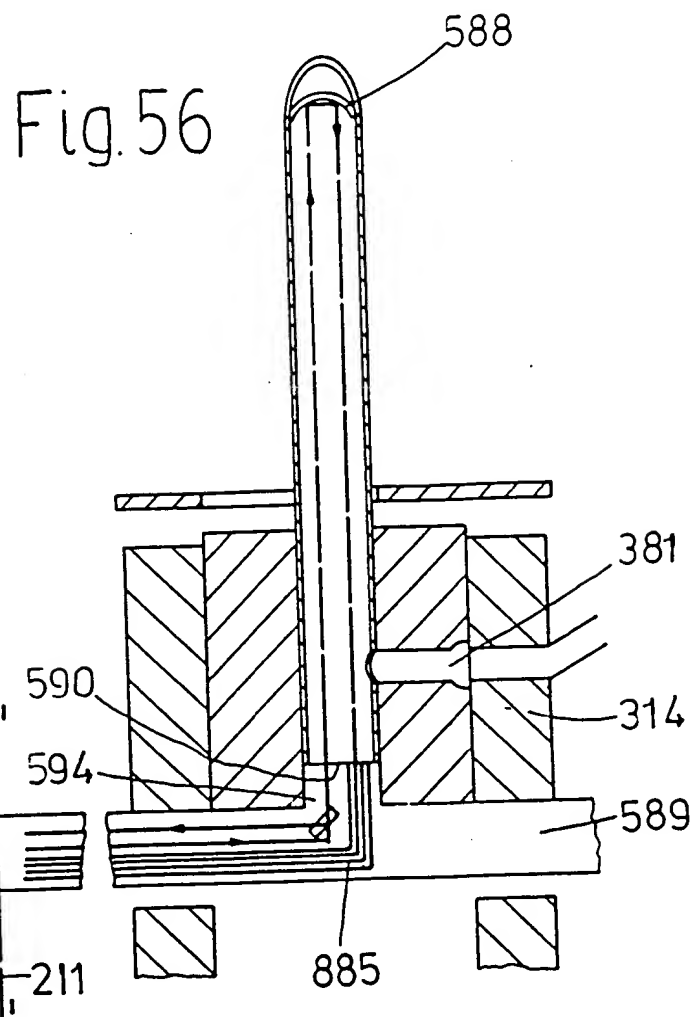
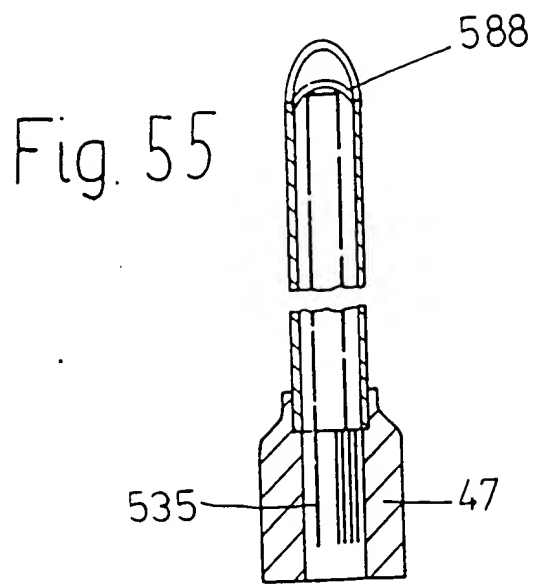


Fig. 53

Fig. 54





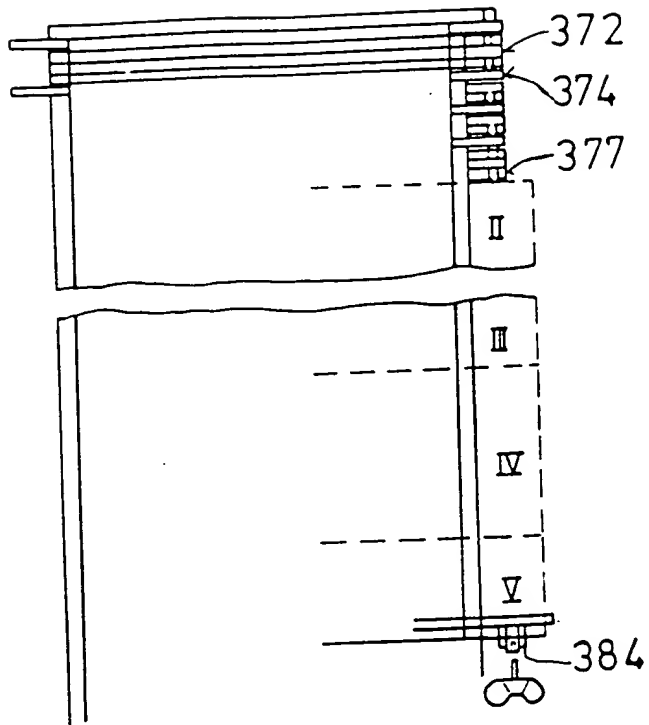
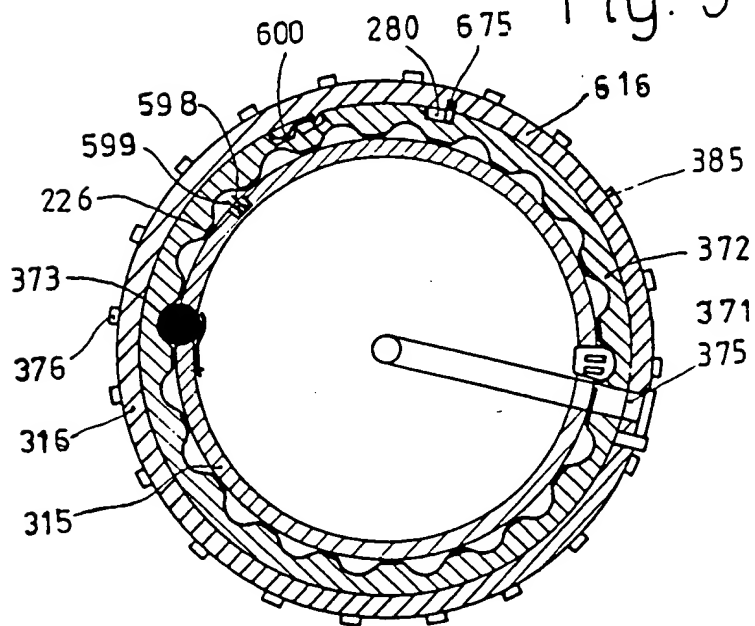


Fig. 57



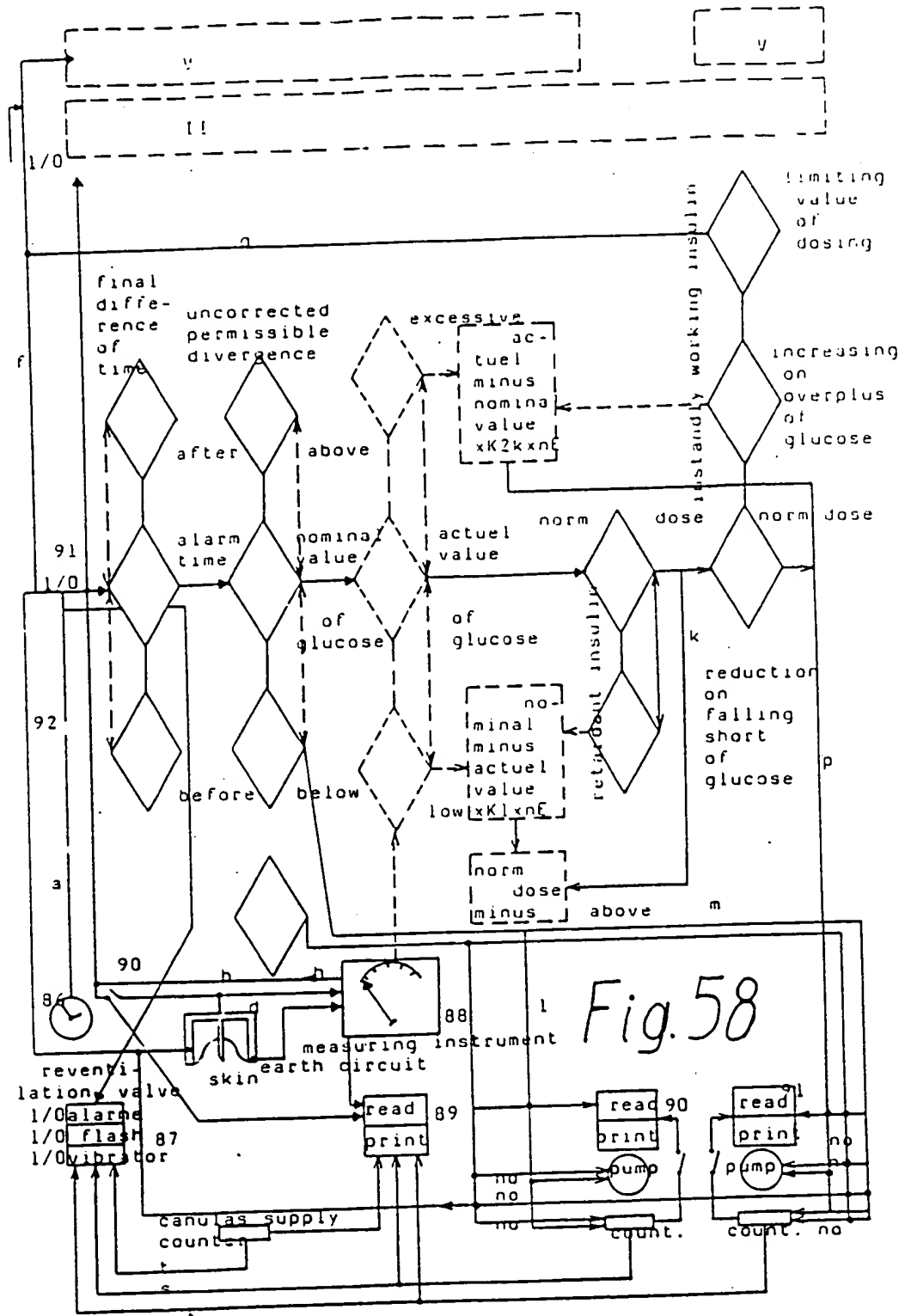
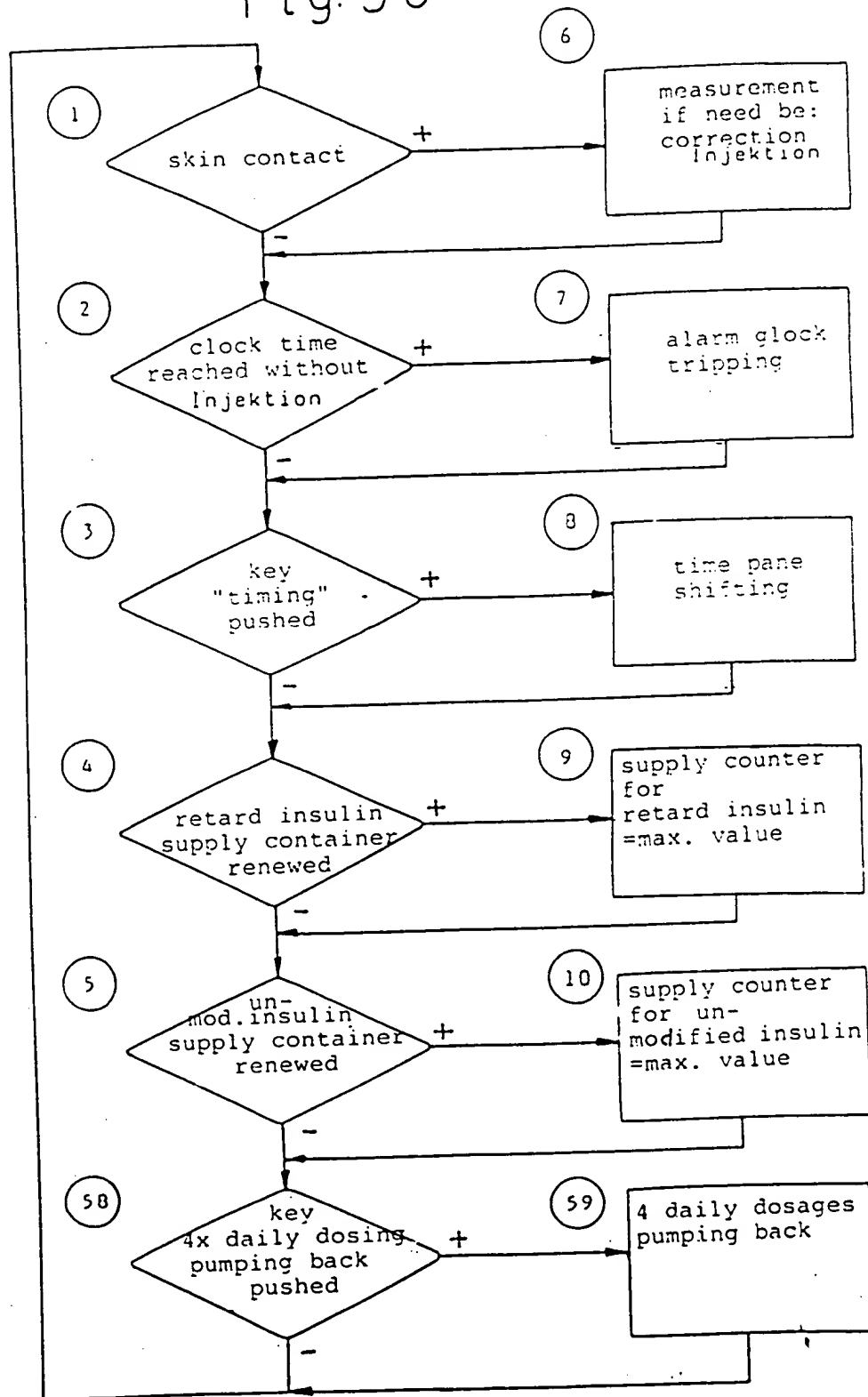


Fig. 58

Fig. 59



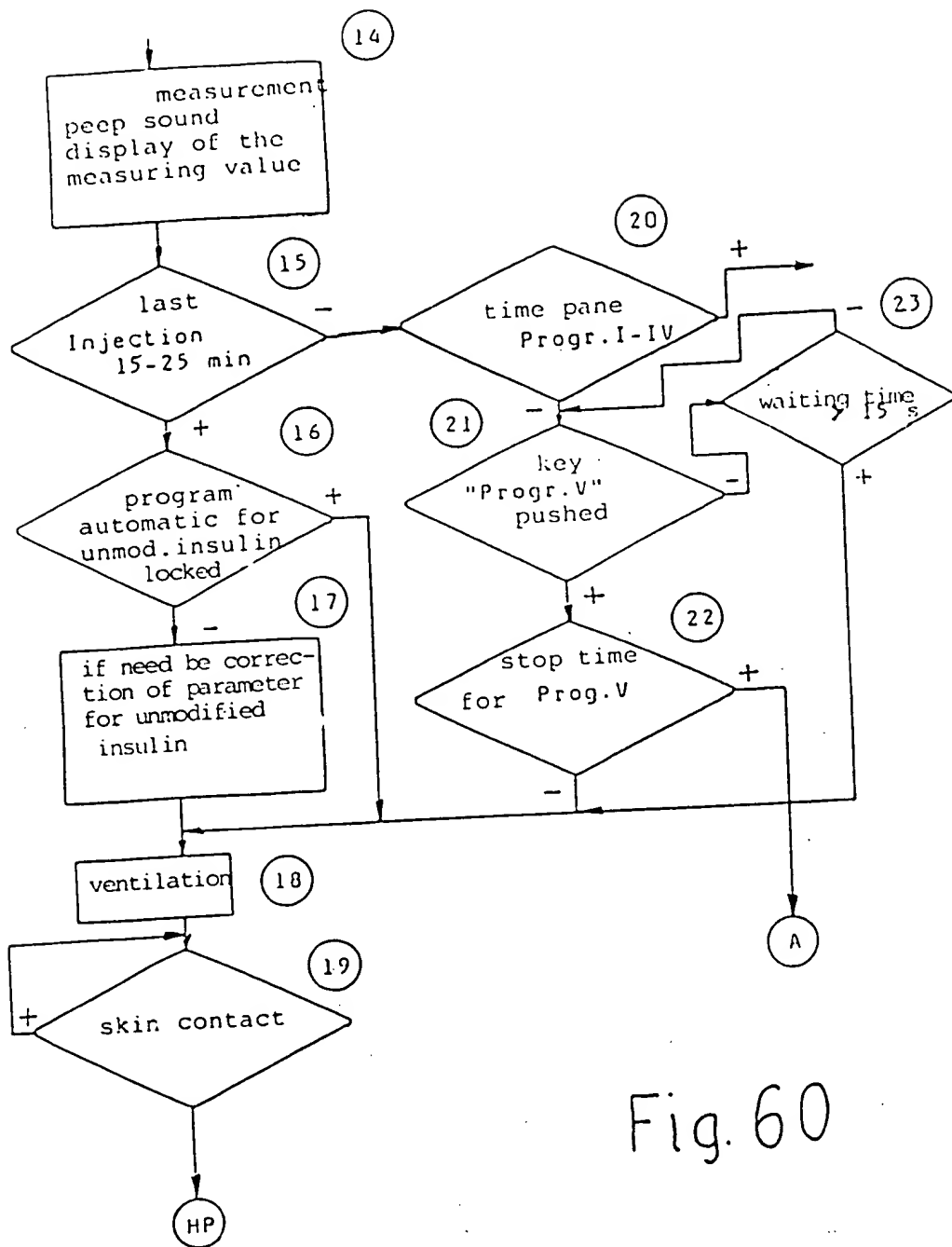
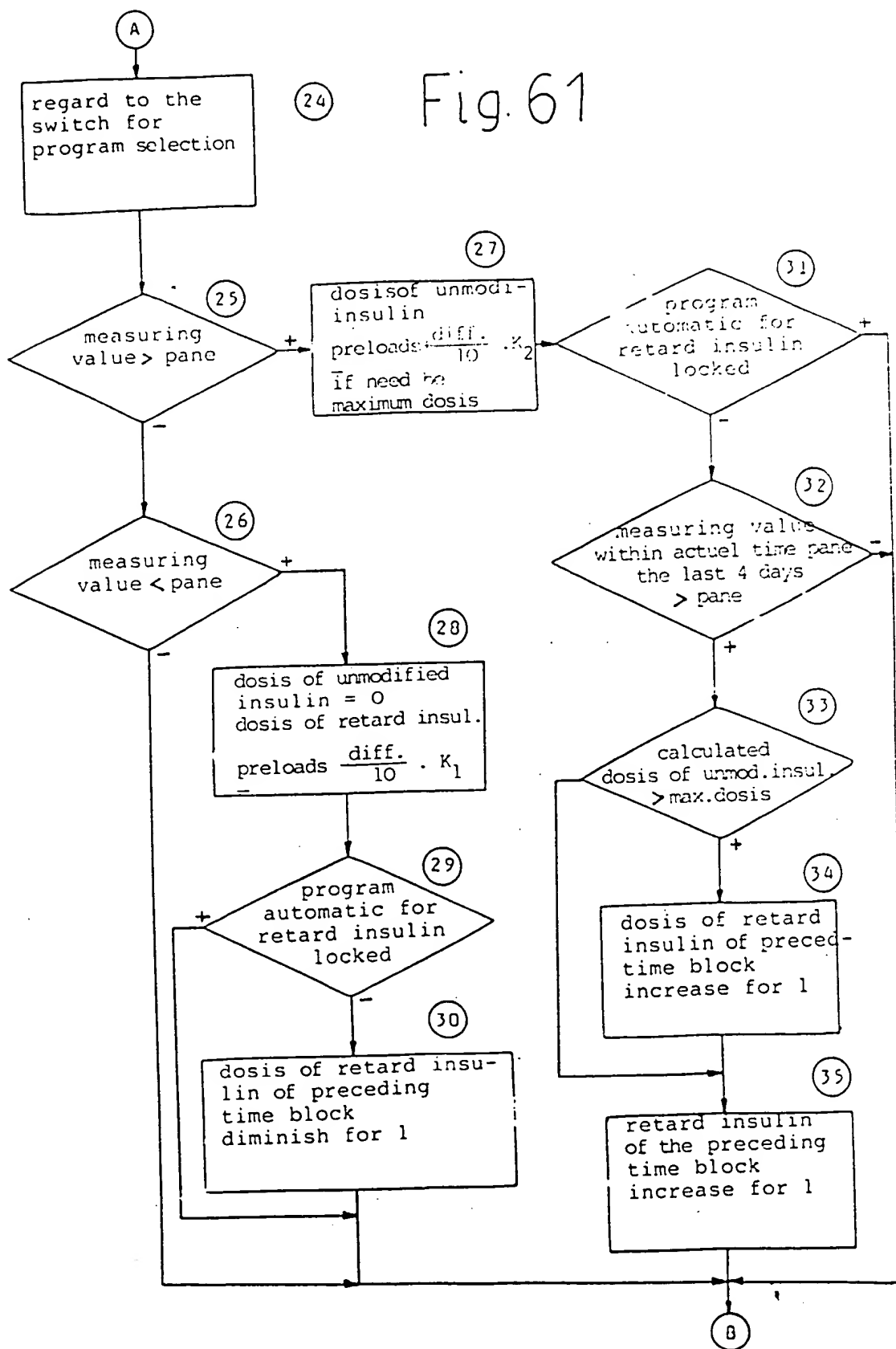


Fig. 60

Fig. 61



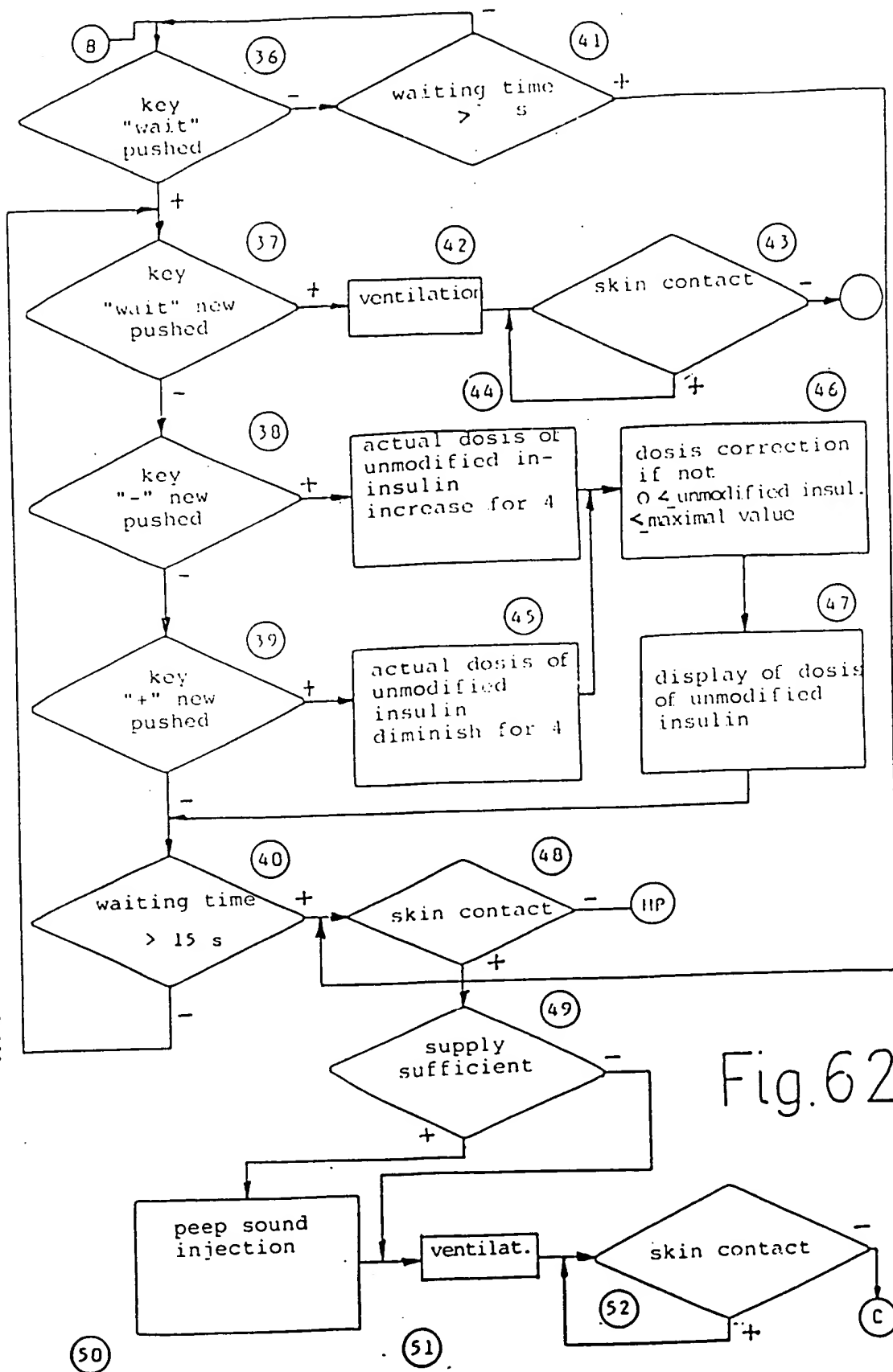


Fig.62

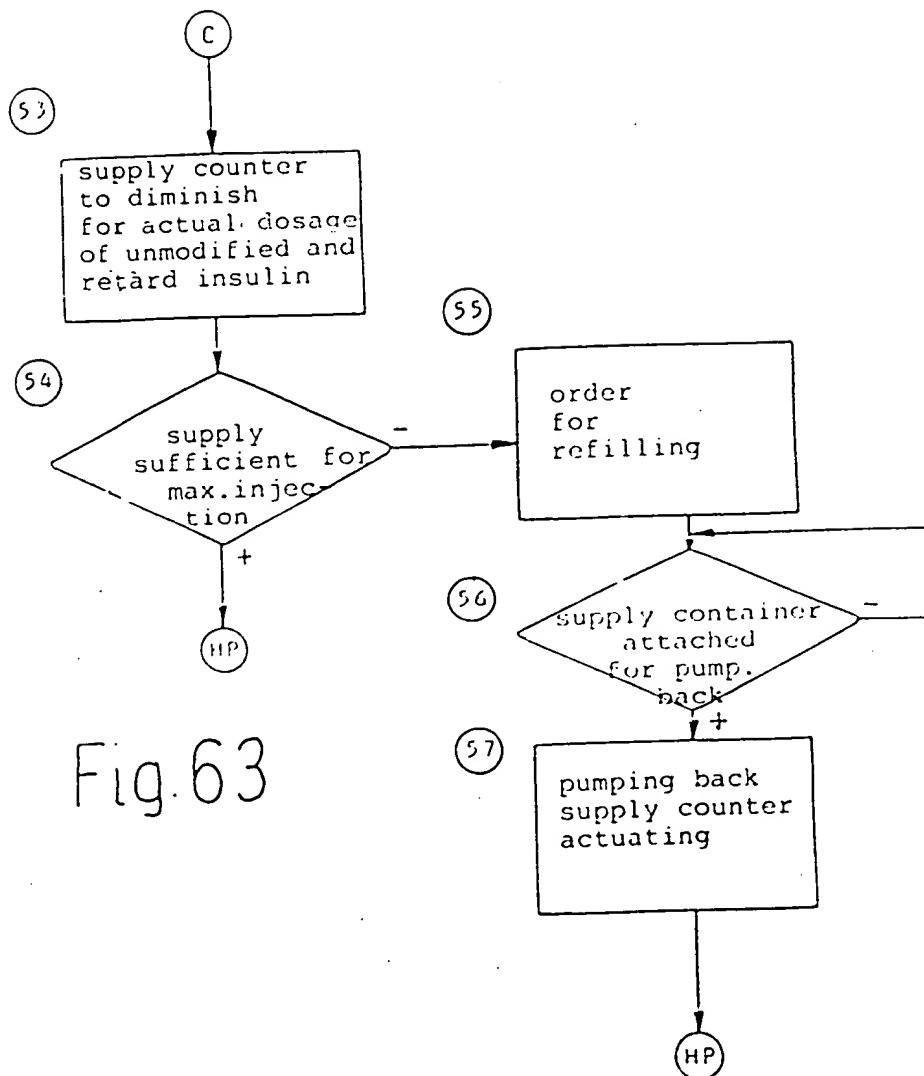


Fig. 63

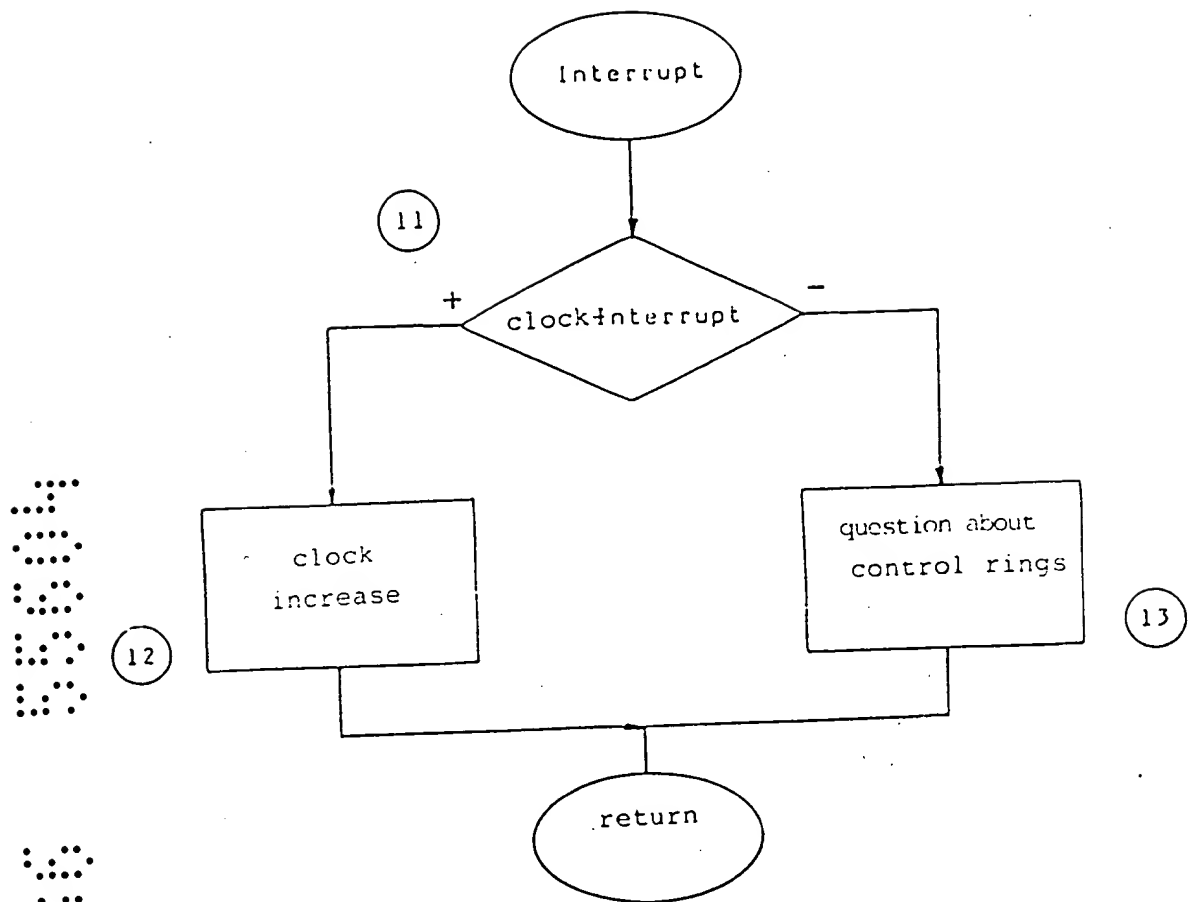


Fig. 64

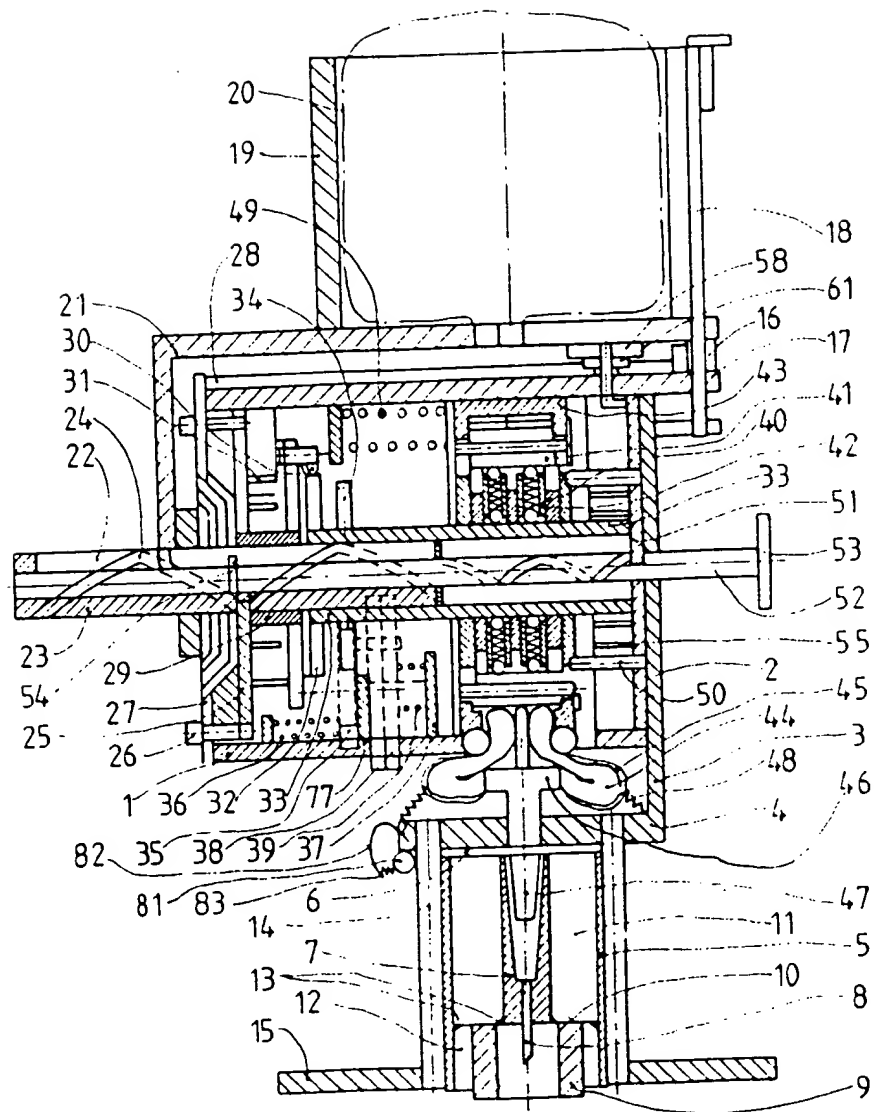


Fig.65

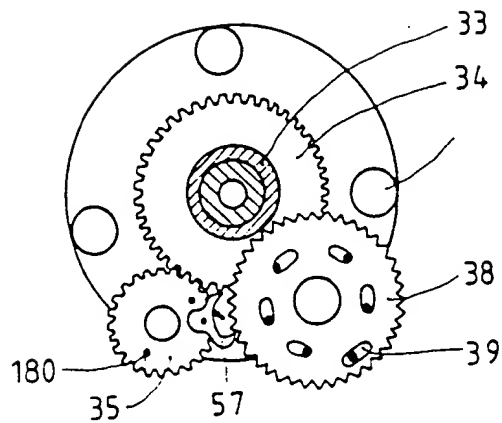


Fig. 67

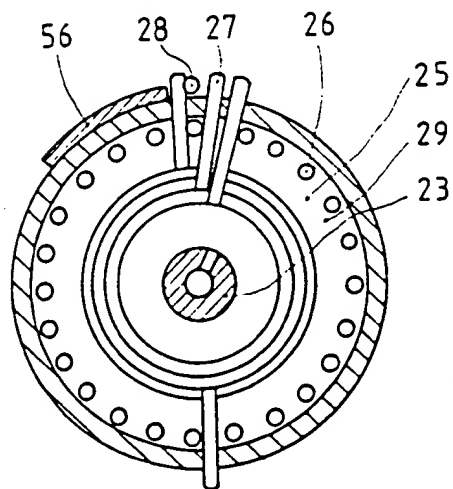


Fig. 66

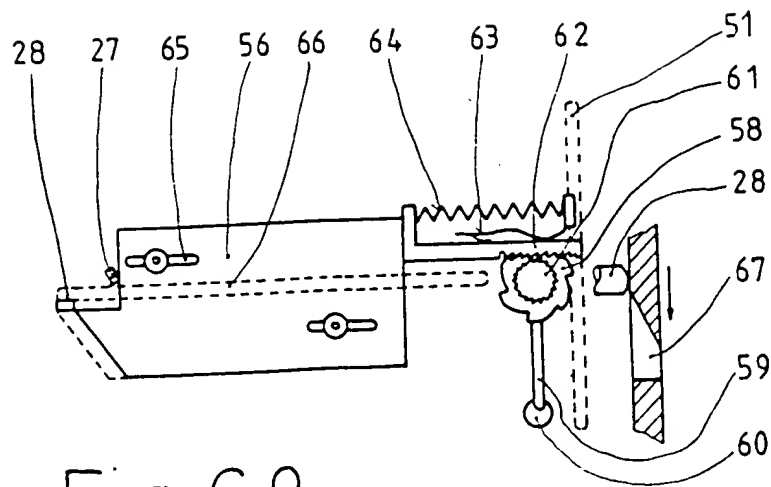


Fig. 68

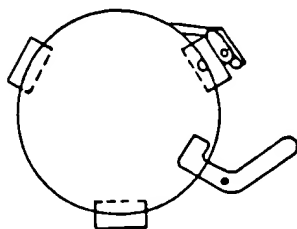


Fig. 69

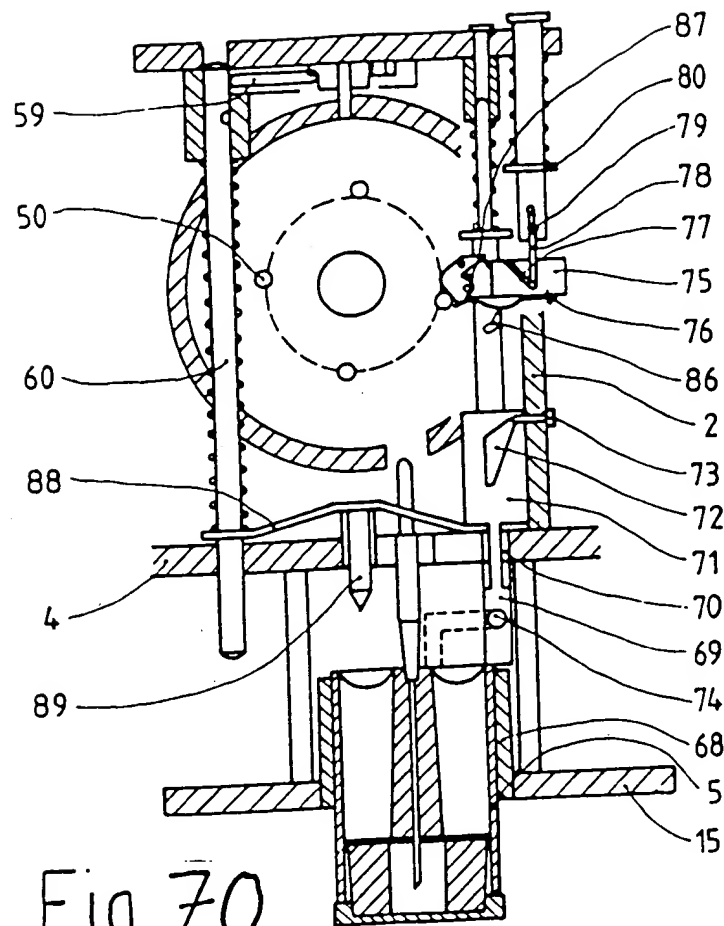


Fig. 70

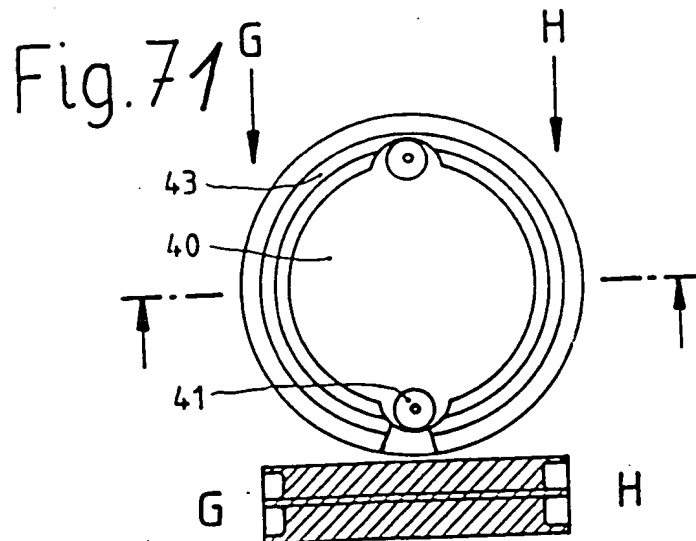


Fig. 71

Fig. 73

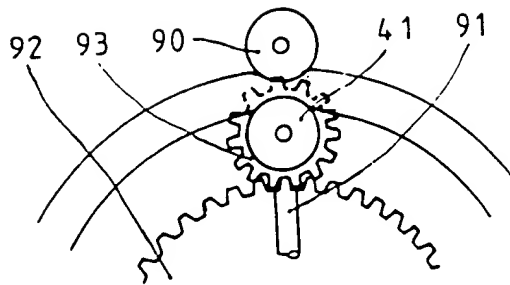


Fig. 74

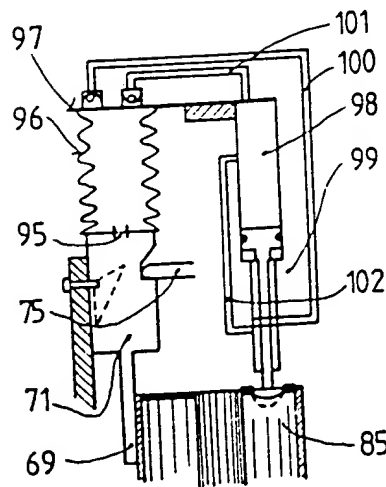
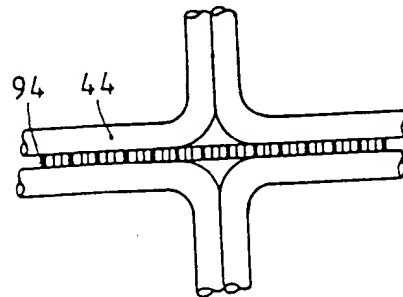


Fig. 75

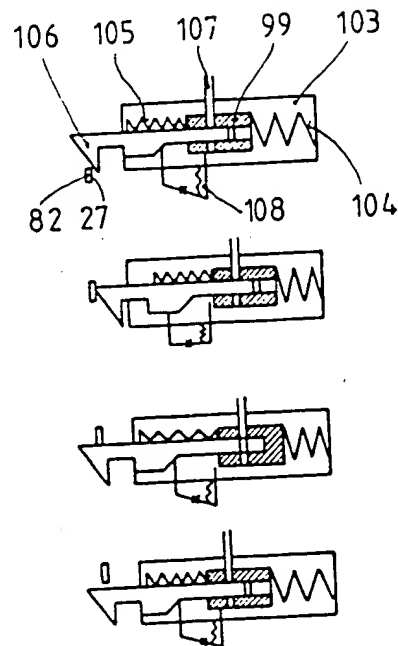
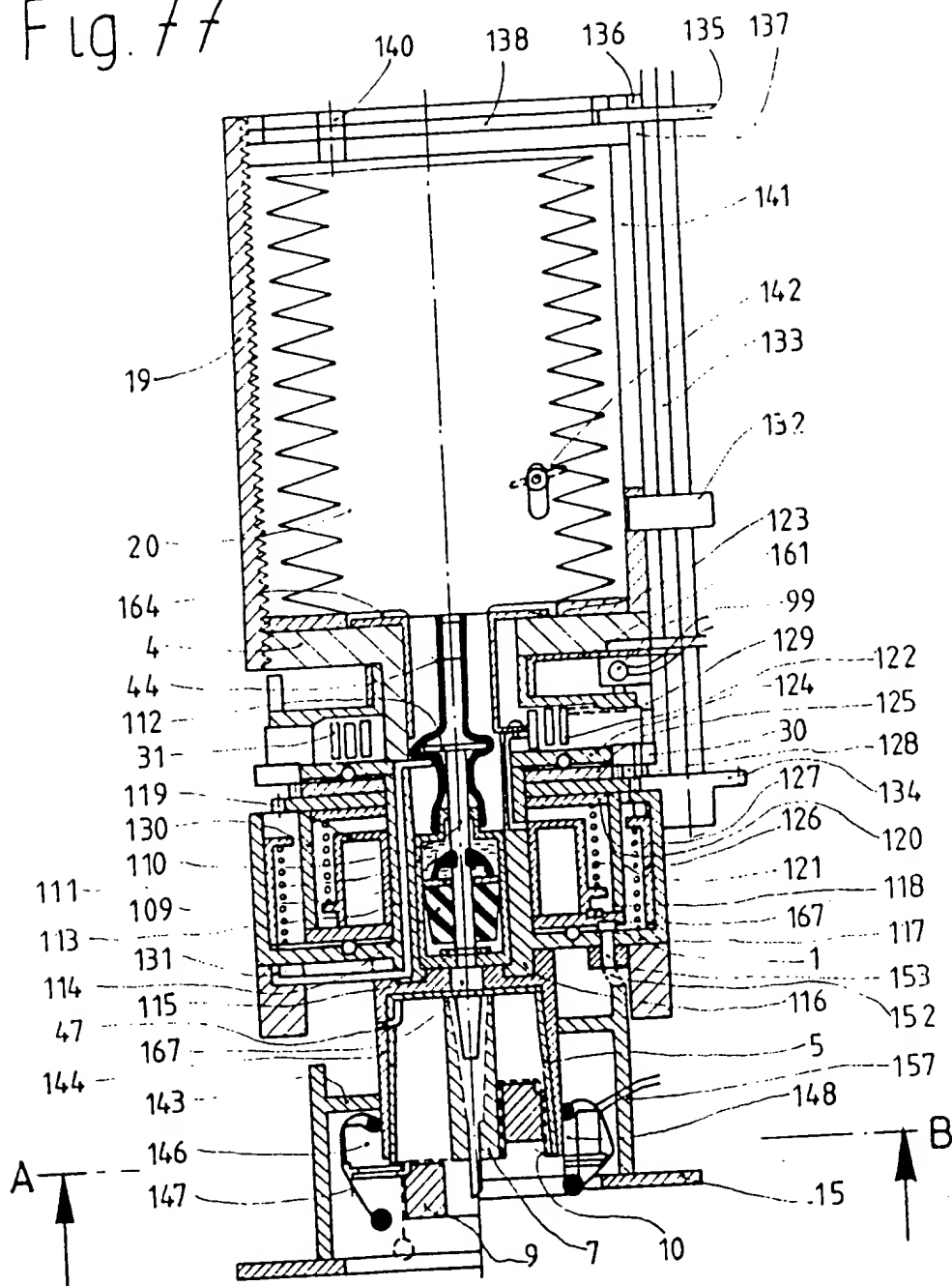


Fig. 76

Fig. 77



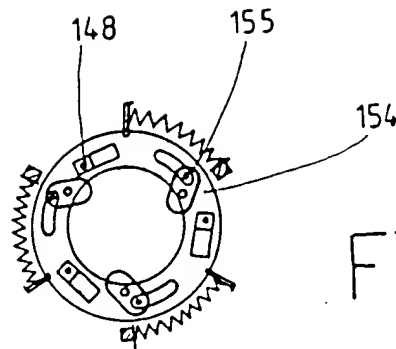


Fig. 78

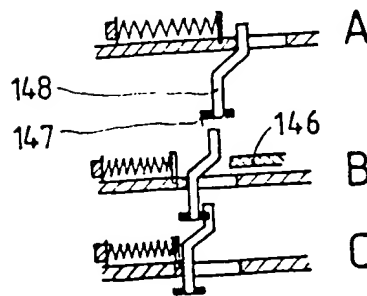


Fig. 79

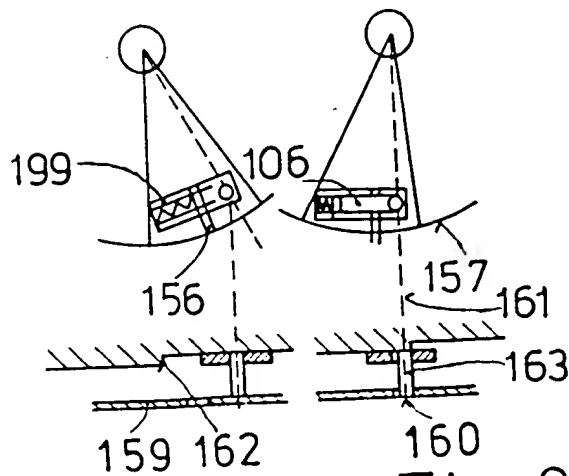


Fig. 80

Fig.81

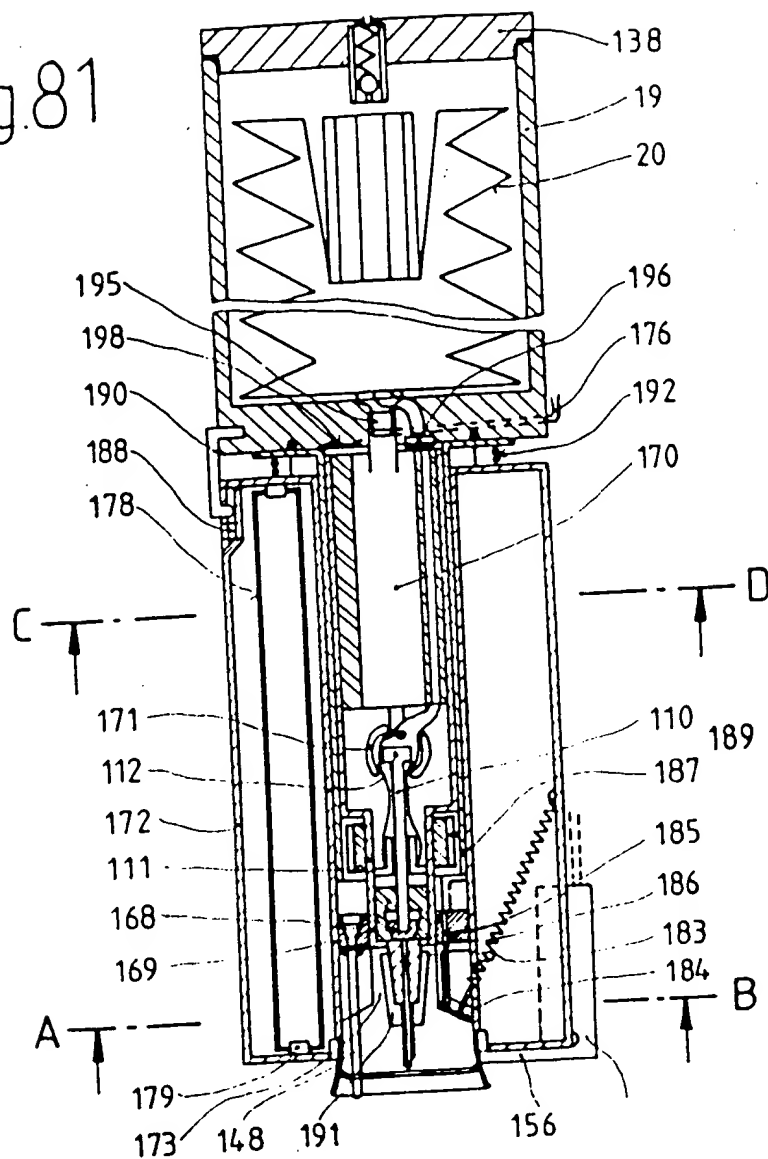
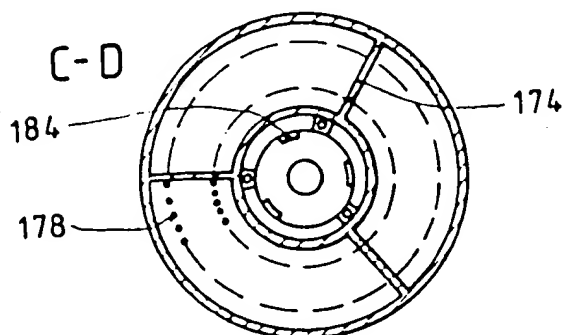


Fig.82 C-D



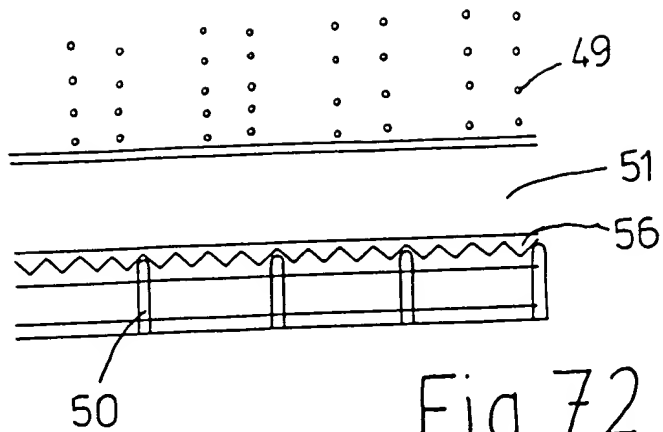


Fig. 72

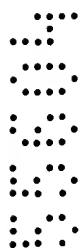
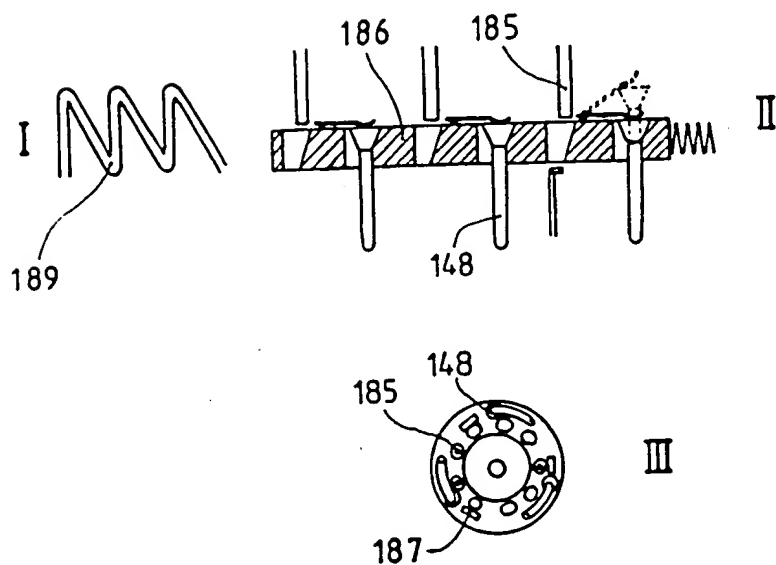


Fig. 83



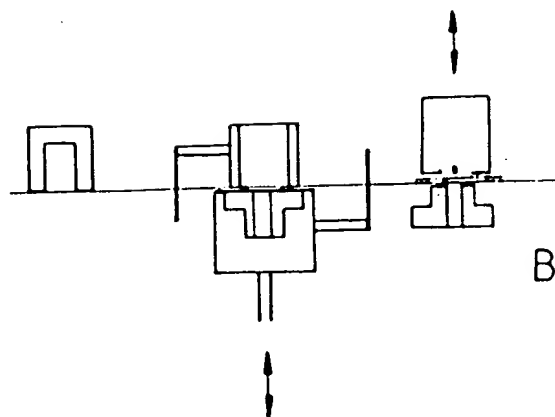
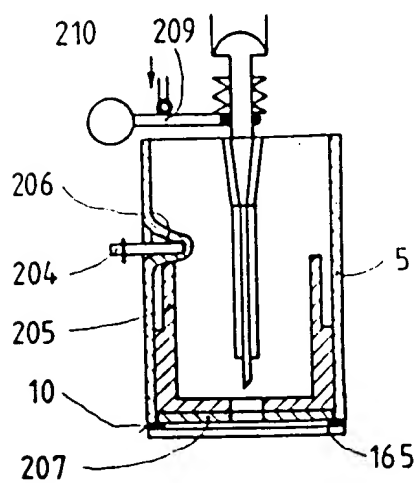
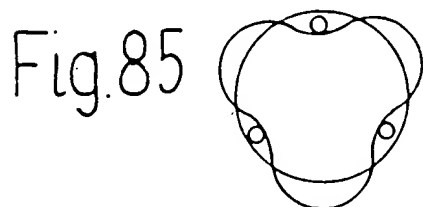
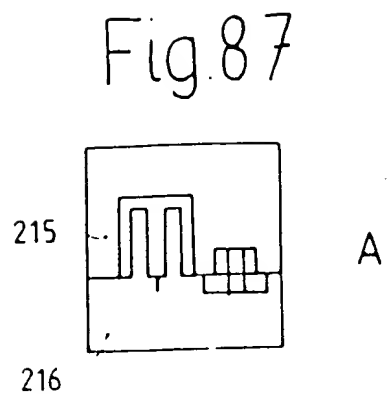
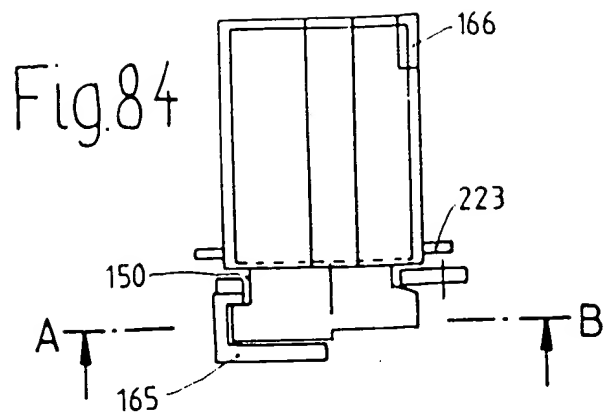
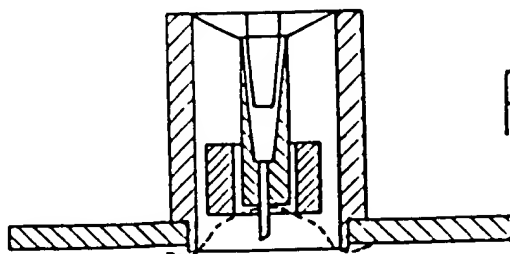
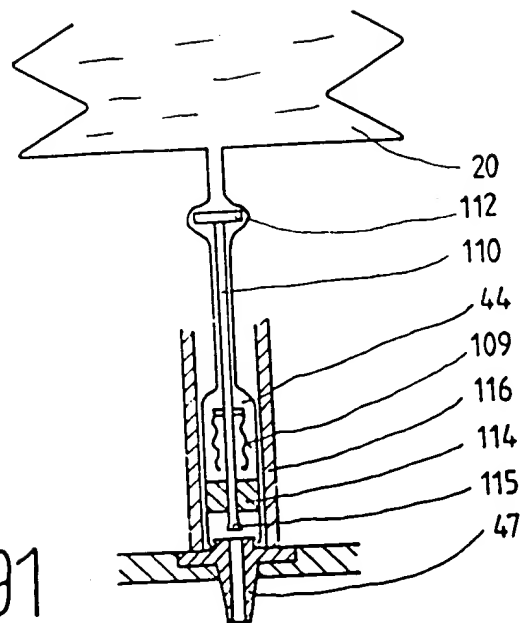
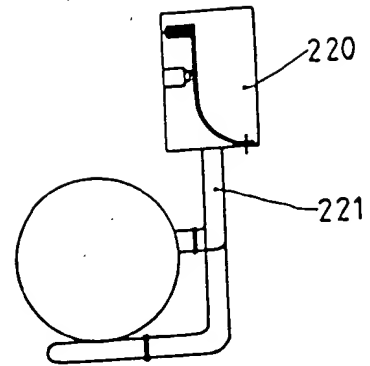
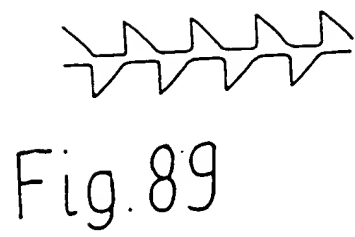


Fig.86

Fig.88





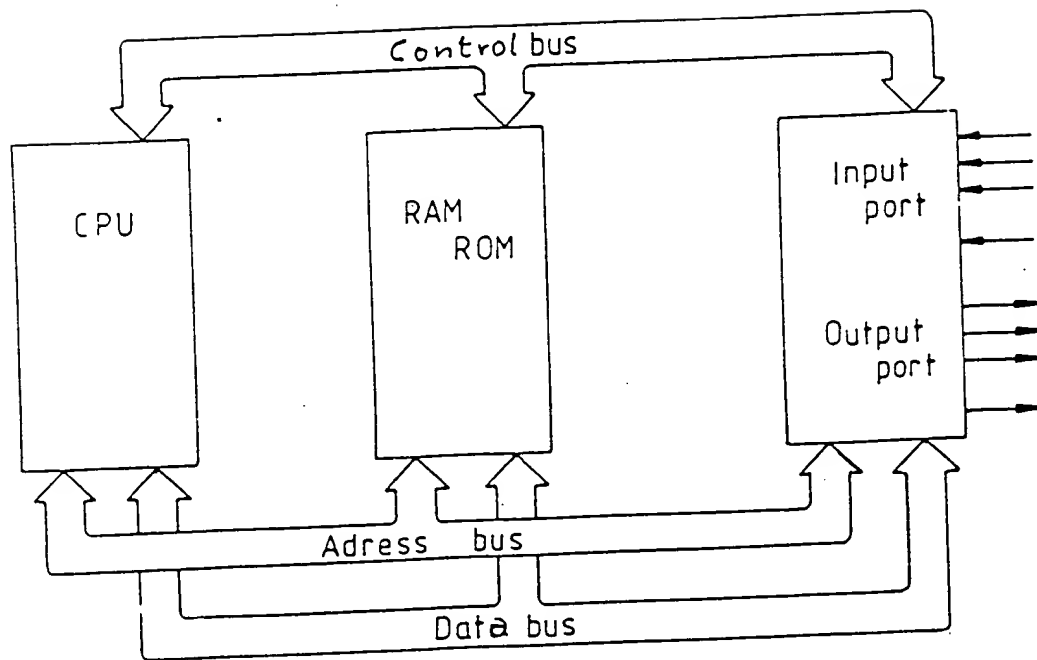


Fig. 92

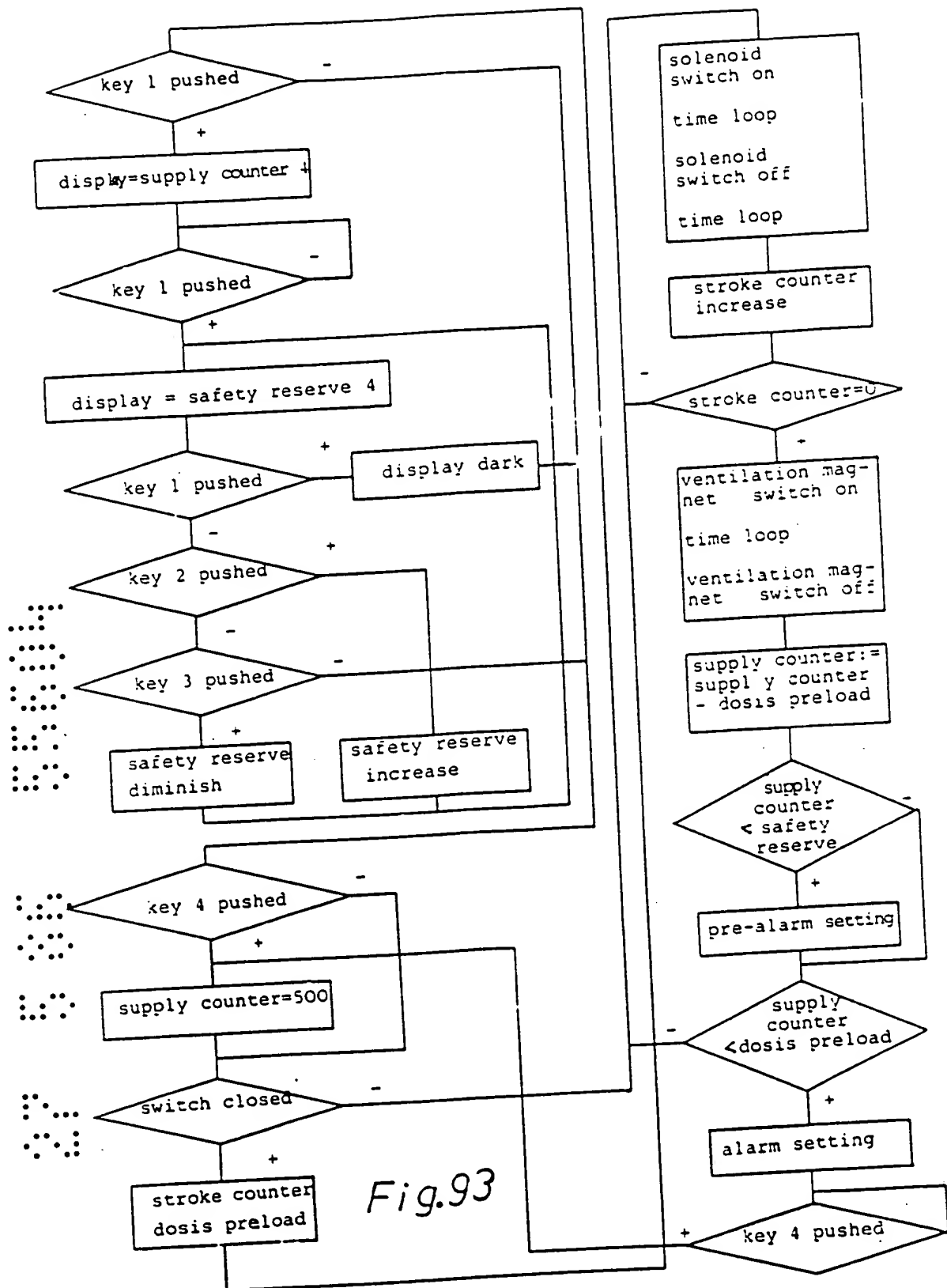


Fig.93

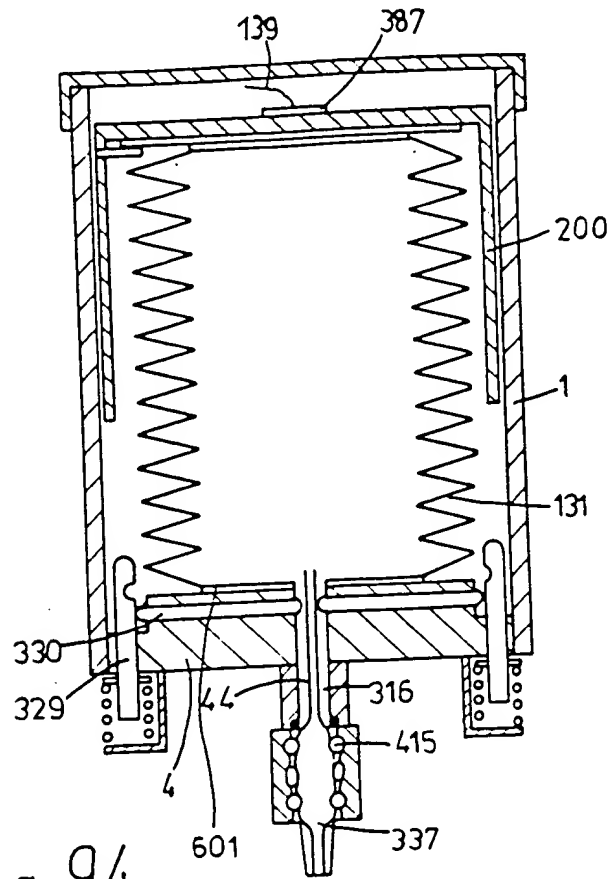


Fig. 94

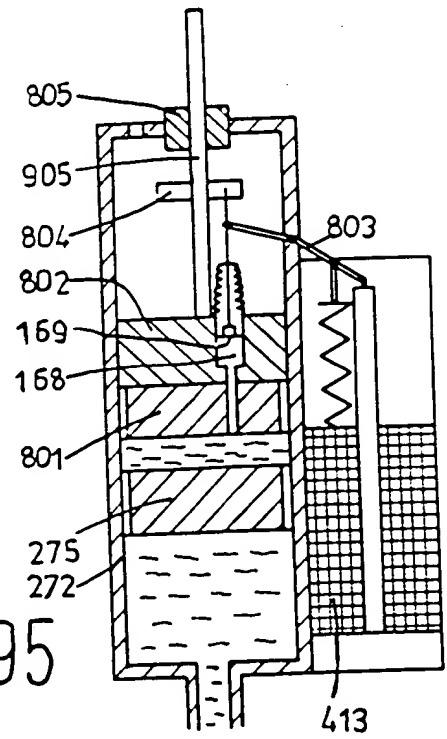


Fig. 95

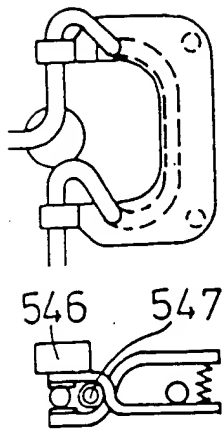


Fig. 96

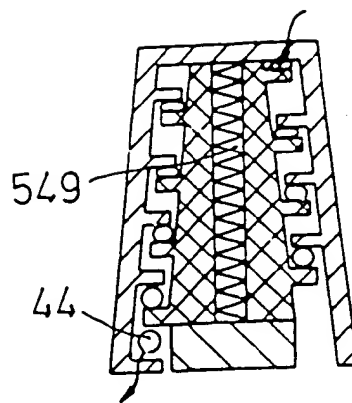


Fig. 97

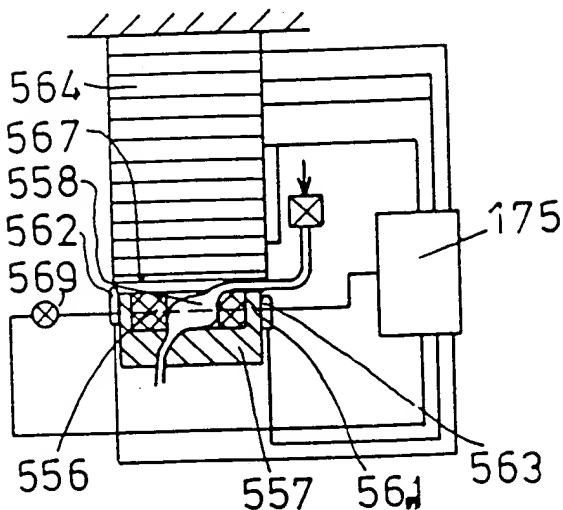


Fig. 98

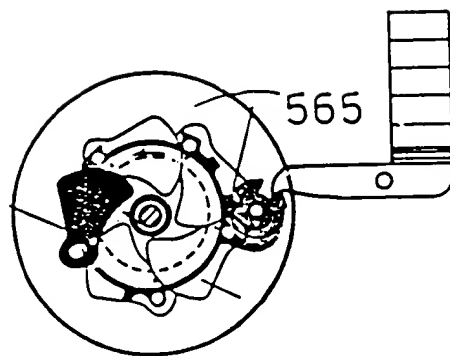
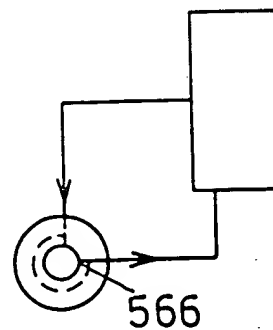


Fig. 99



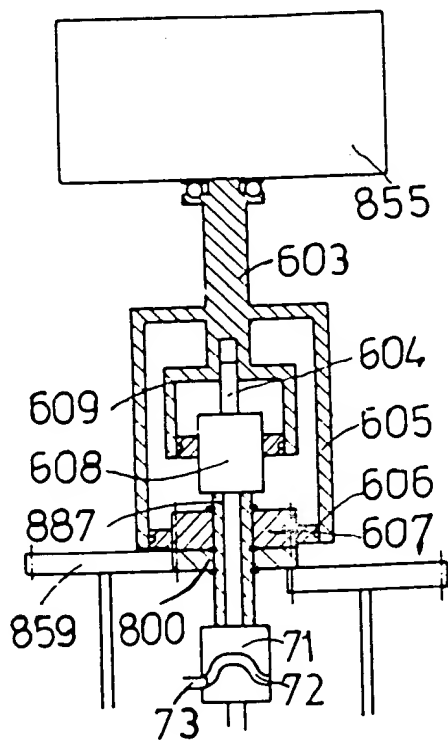


Fig. 100

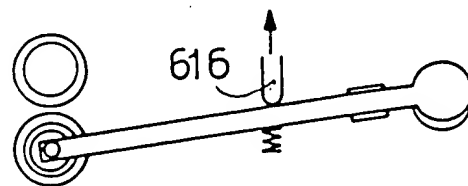
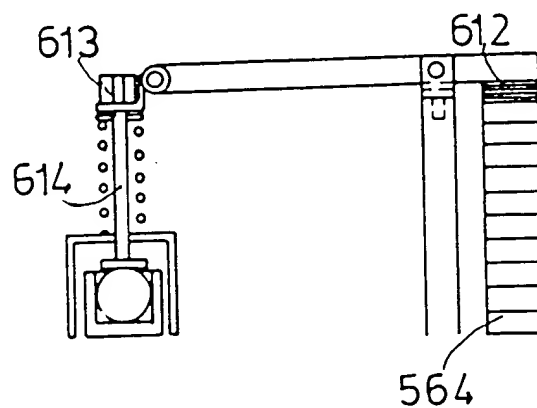


Fig. 101

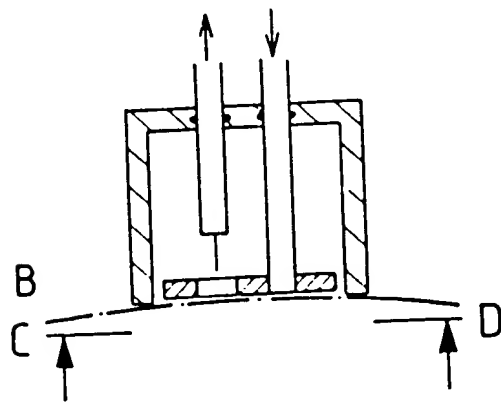
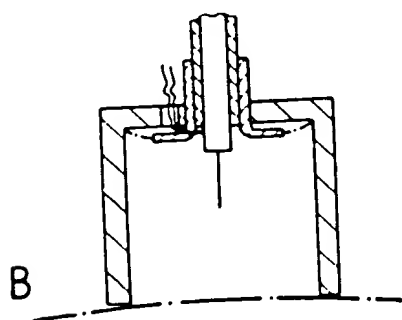
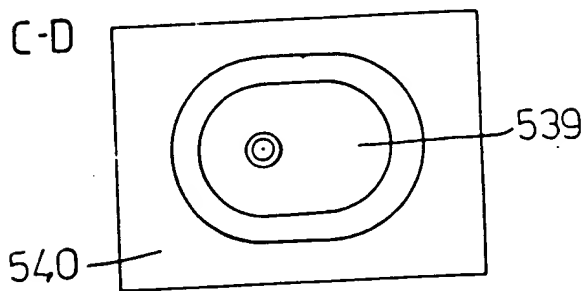
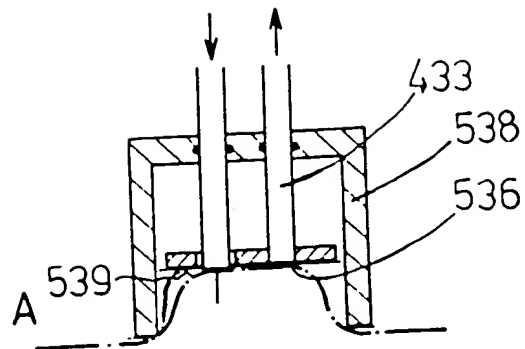
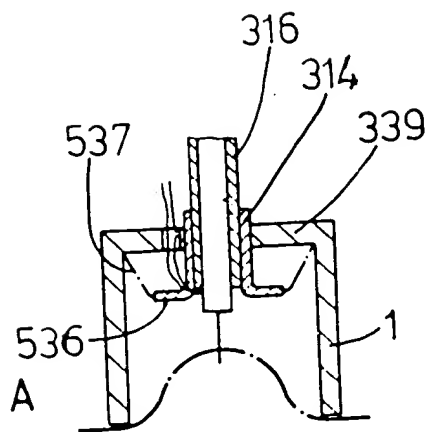


Fig. 102

Fig. 103

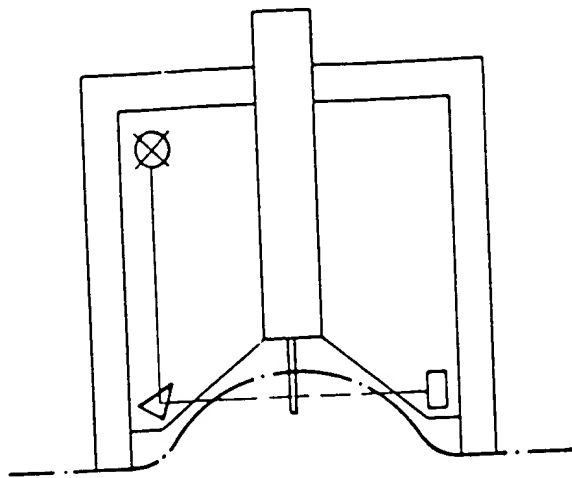


Fig. 104

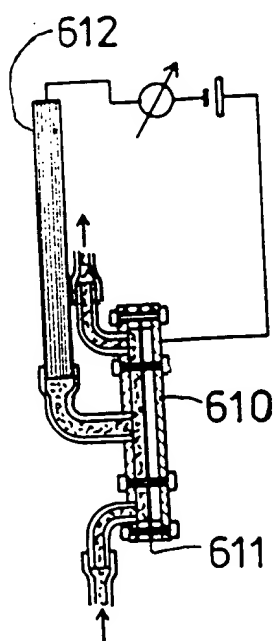
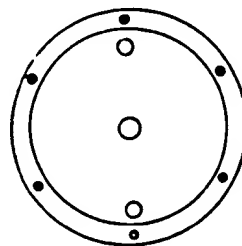


Fig. 105



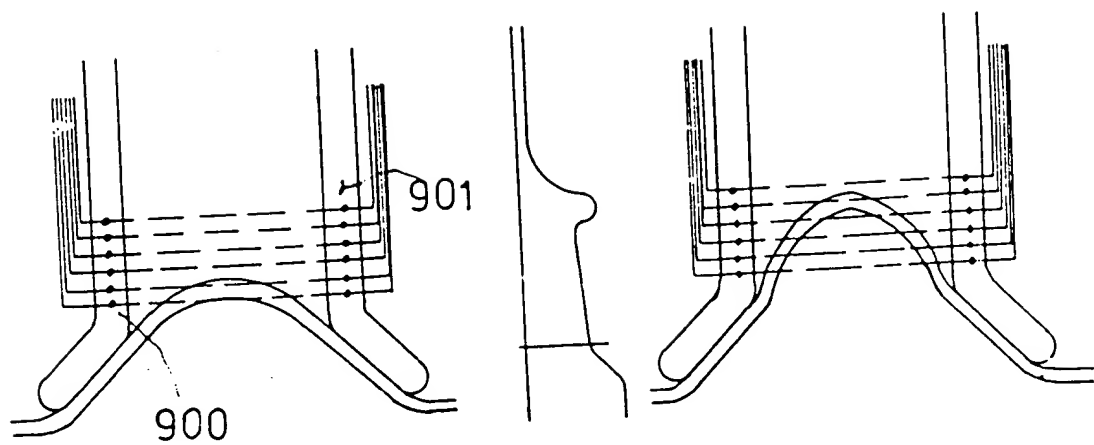


Fig. 106

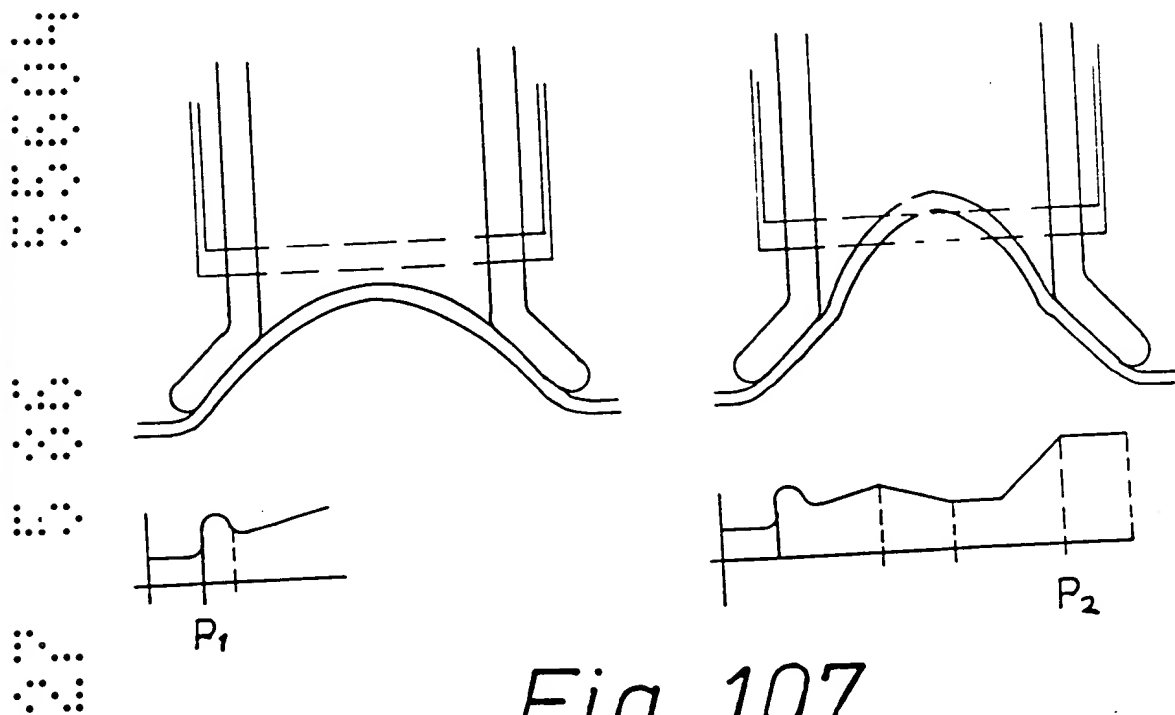


Fig. 107

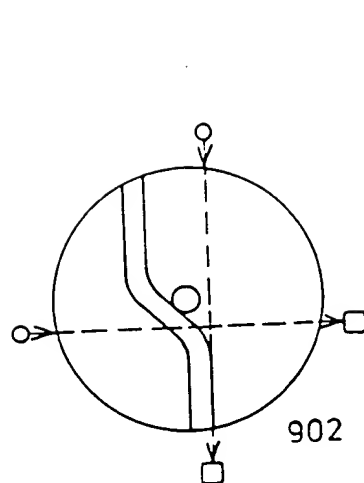


Fig. 108

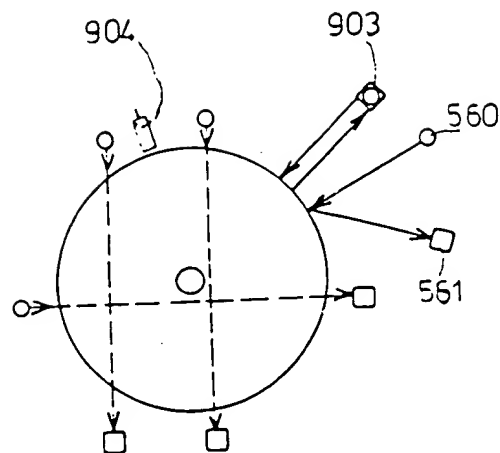


Fig. 109

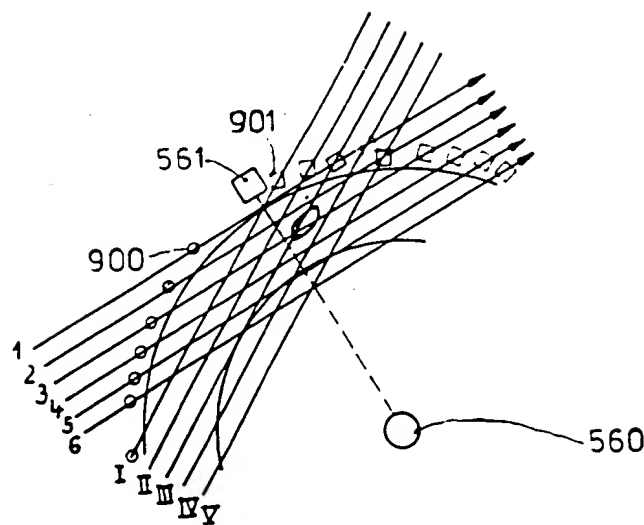


Fig. 110

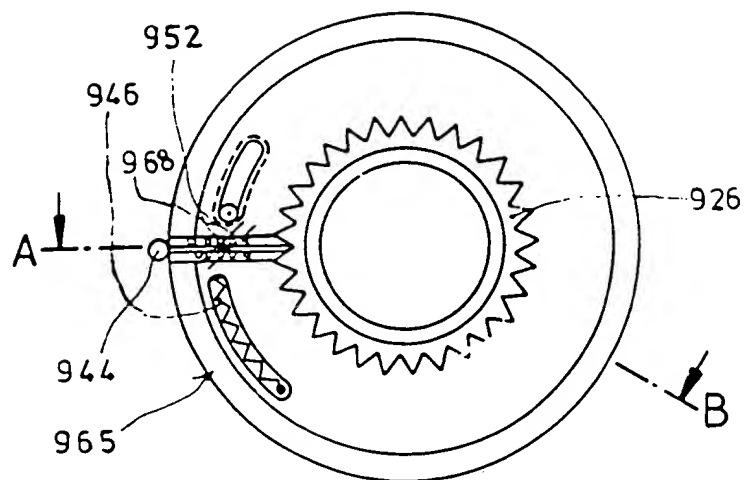


Fig. 113

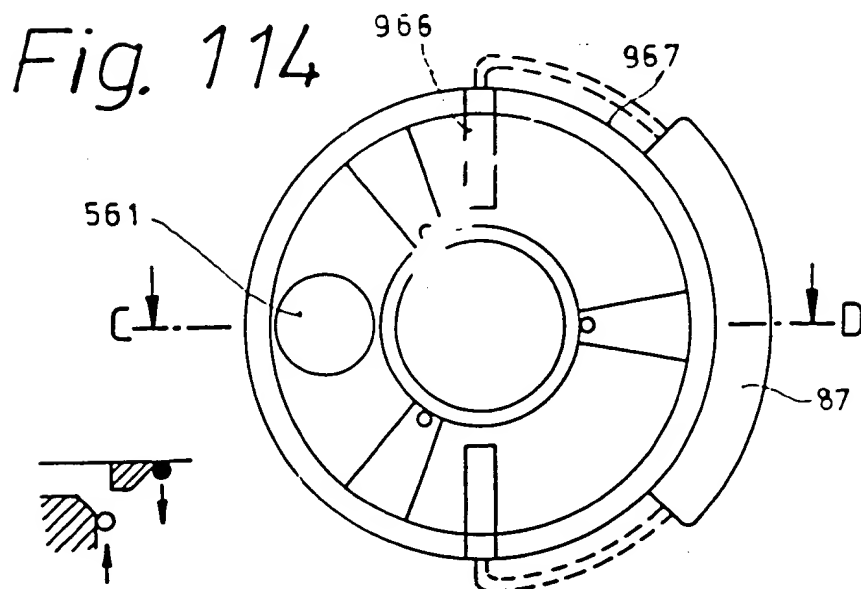


Fig. 114

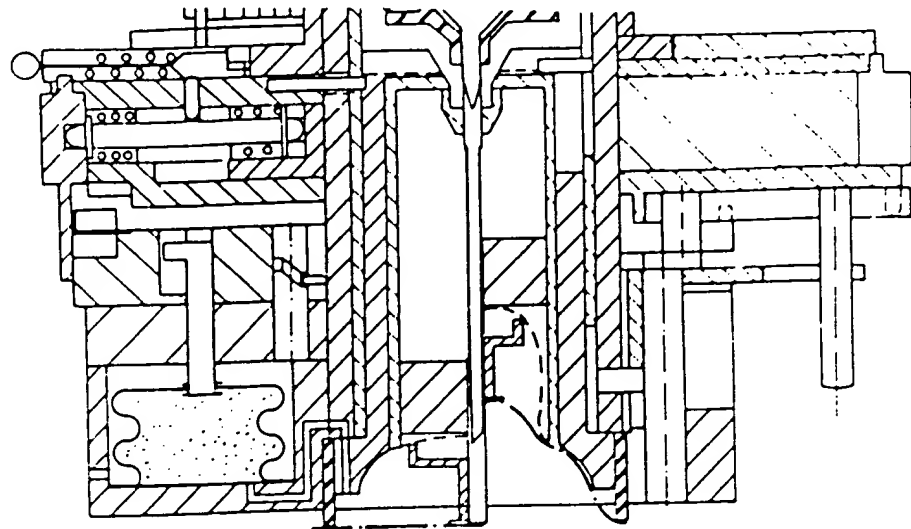
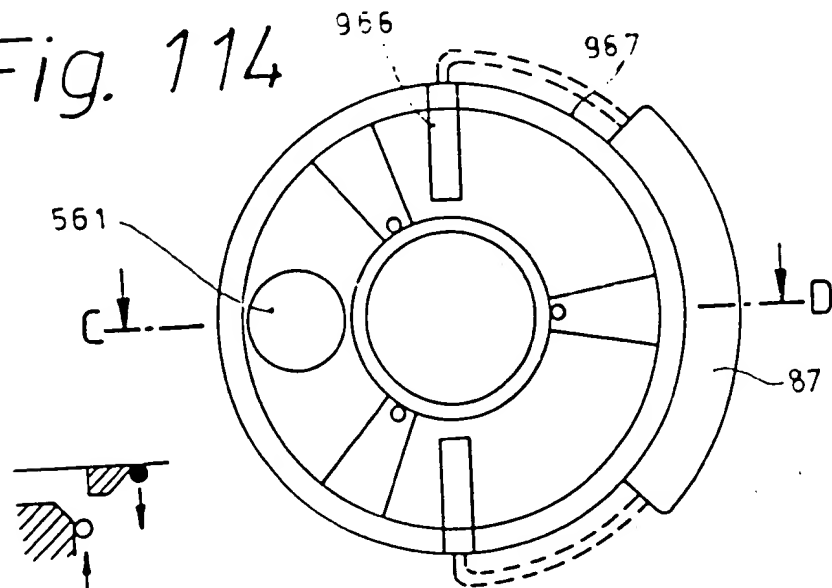


Fig. 114



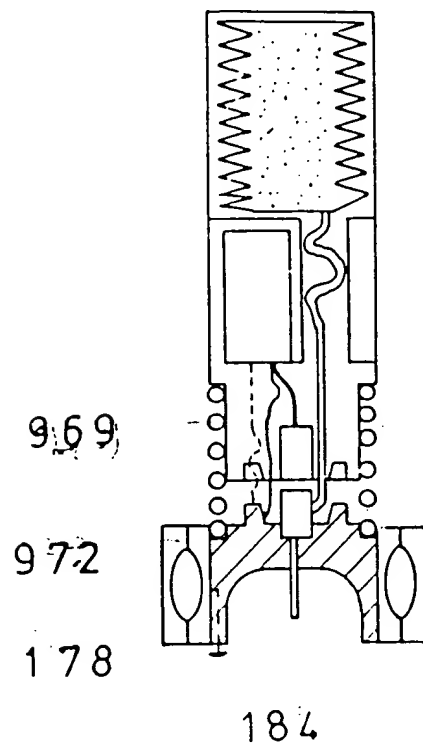


Fig. 115

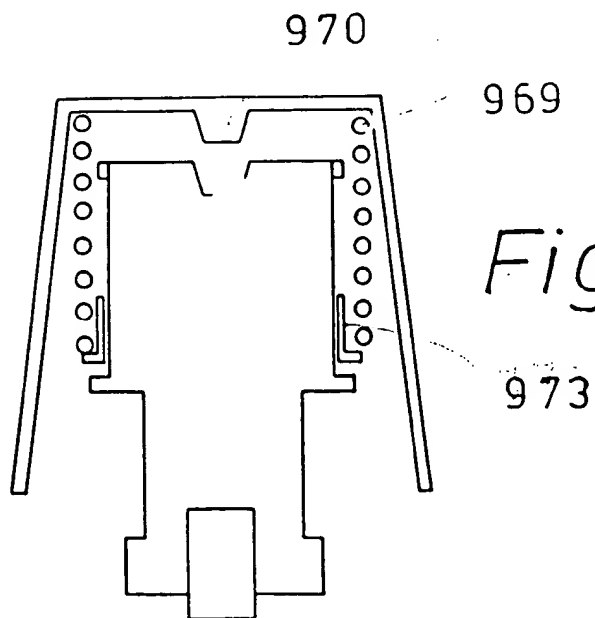


Fig. 116

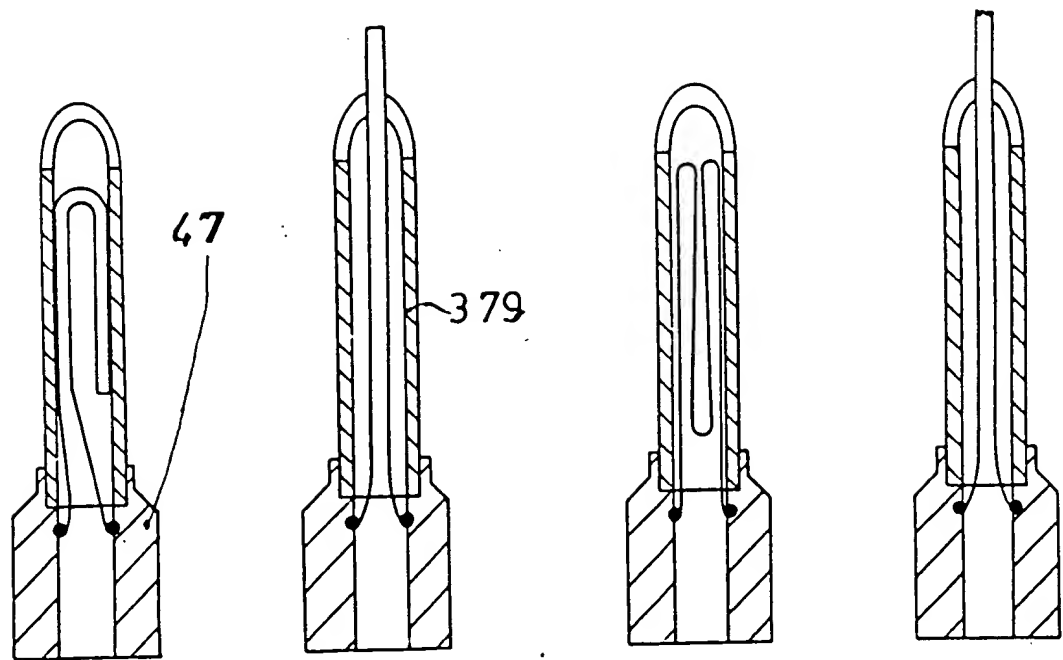


Fig. 117

Fig. 118

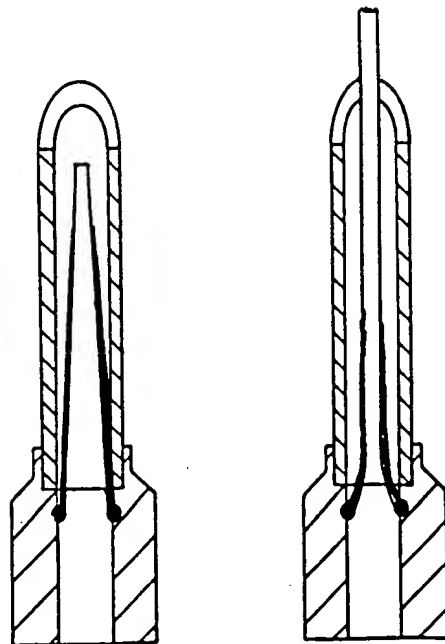


Fig. 119

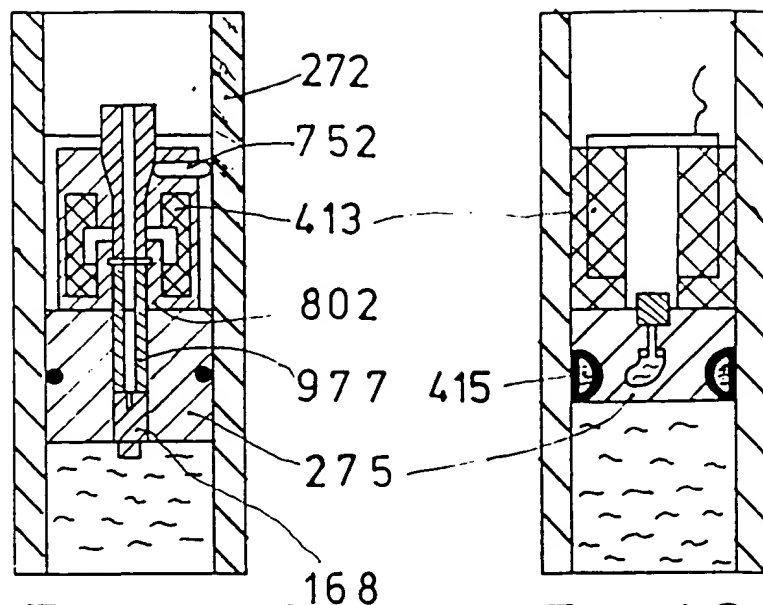


Fig. 120¹⁶⁸

Fig. 121

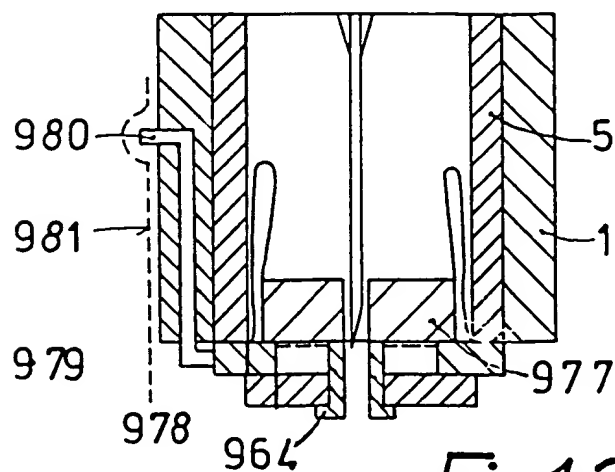
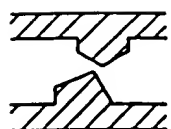
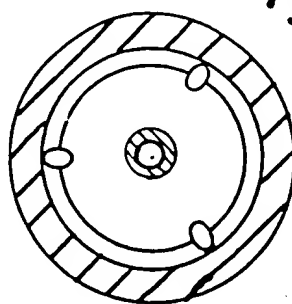


Fig. 122



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